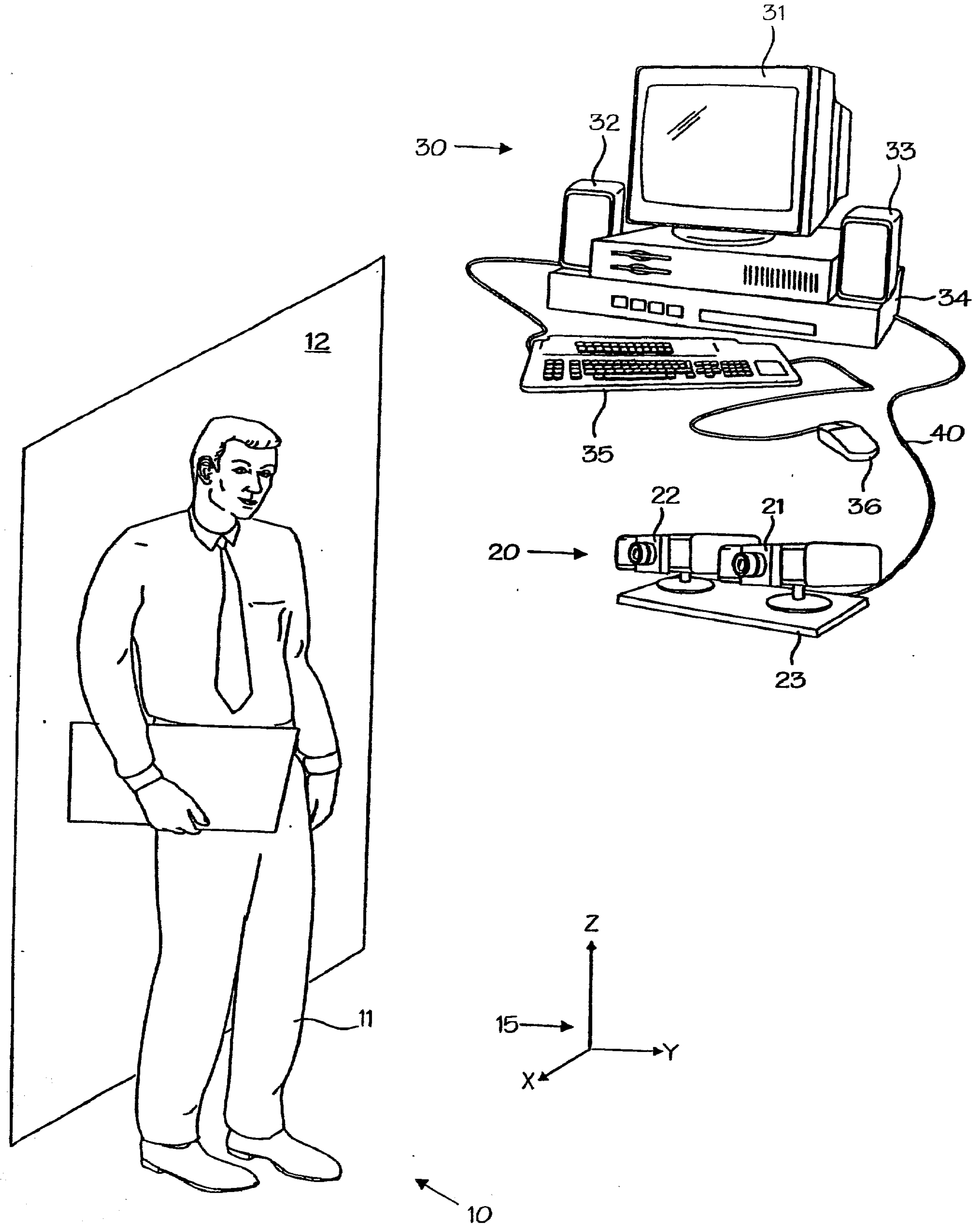


FIG. 1

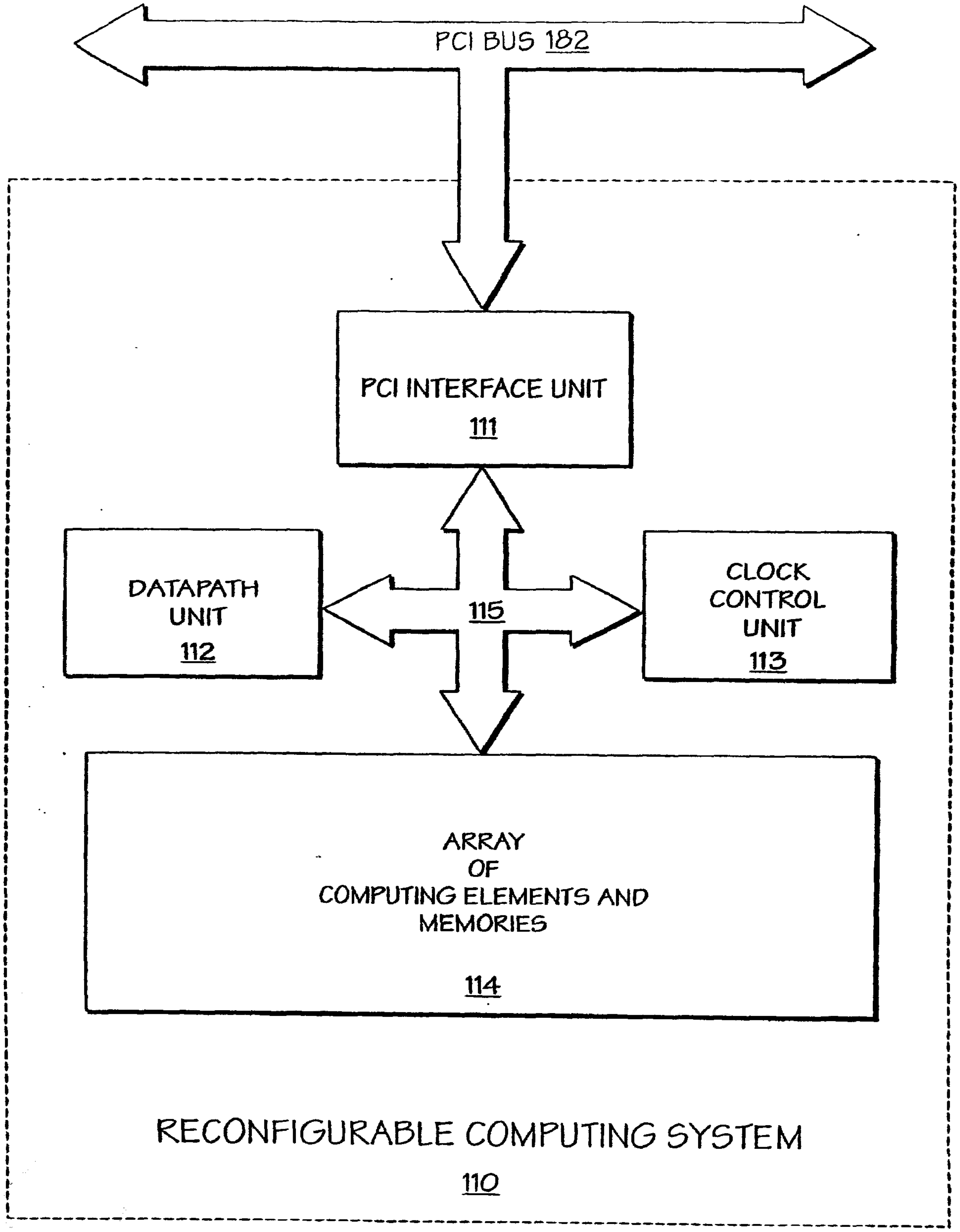

PCI BUS 182
PCI INTERFACE UNIT
111
DATAPATH
UNIT
112
115
CLOCK
CONTROL
UNIT
113
ARRAY
OF
COMPUTING ELEMENTS AND
MEMORIES
114
RECONFIGURABLE COMPUTING SYSTEM
110

FIG. 3

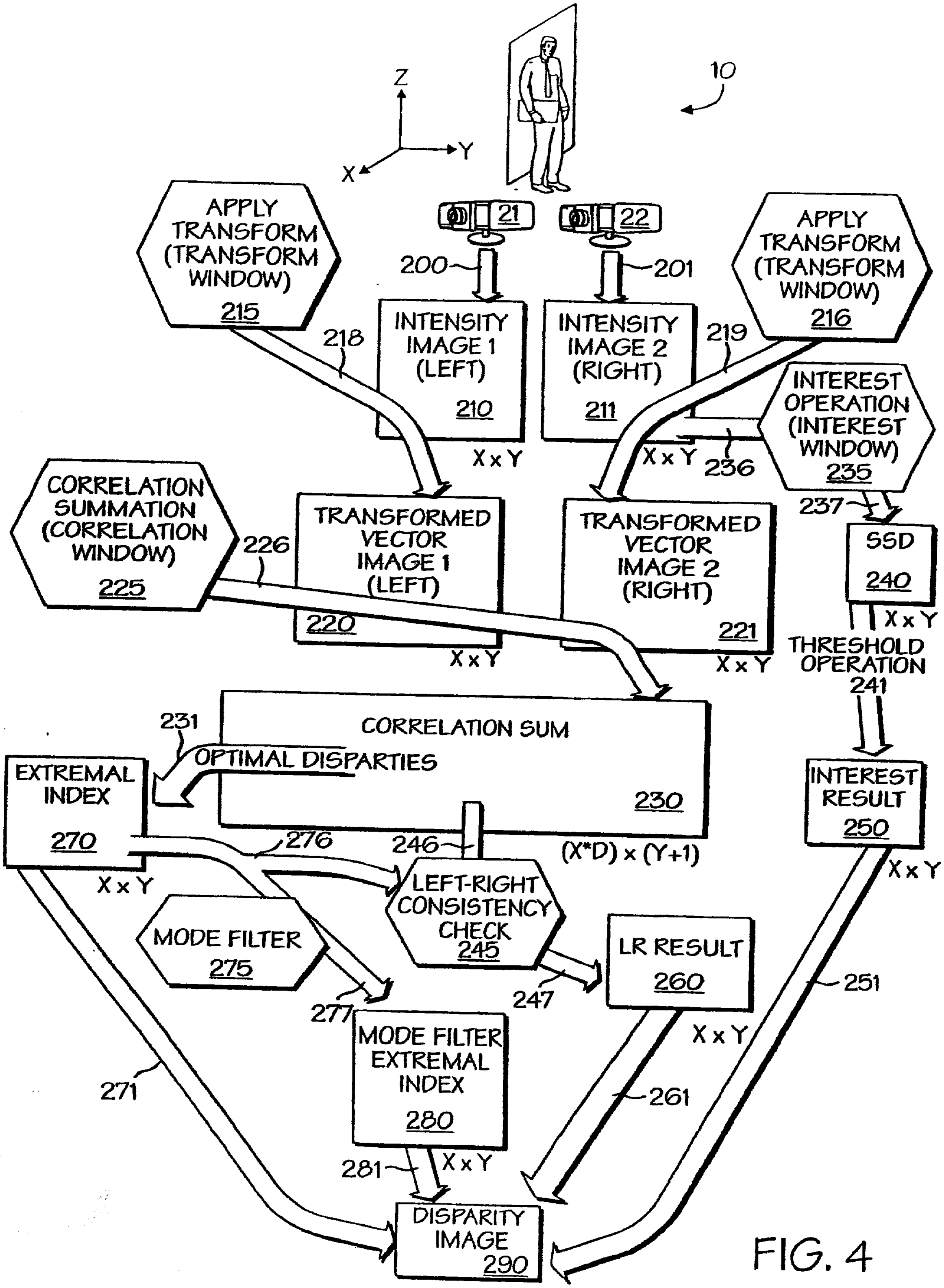

10
Z
Y
X
21
22
200
201
APPLY TRANSFORM (TRANSFORM WINDOW) 215
APPLY TRANSFORM (TRANSFORM WINDOW) 216
INTENSITY IMAGE 1 (LEFT) 210
INTENSITY IMAGE 2 (RIGHT) 211
218
219
X x Y
X x Y
236
INTEREST OPERATION (INTEREST WINDOW) 235
237
SSD 240
CORRELATION SUMMATION (CORRELATION WINDOW) 225
226
TRANSFORMED VECTOR IMAGE 1 (LEFT) 220
TRANSFORMED VECTOR IMAGE 2 (RIGHT) 221
X x Y
X x Y
X x Y
THRESHOLD OPERATION 241
CORRELATION SUM 230
231
OPTIMAL DISPARTIES
(X*D) x (Y+1)
EXTREMAL INDEX 270
INTEREST RESULT 250
276
246
X x Y
LEFT-RIGHT CONSISTENCY CHECK 245
X x Y
MODE FILTER 275
LR RESULT 260
247
251
277
MODE FILTER EXTREMAL INDEX 280
X x Y
271
261
281
X x Y
DISPARITY IMAGE 290

FIG. 4

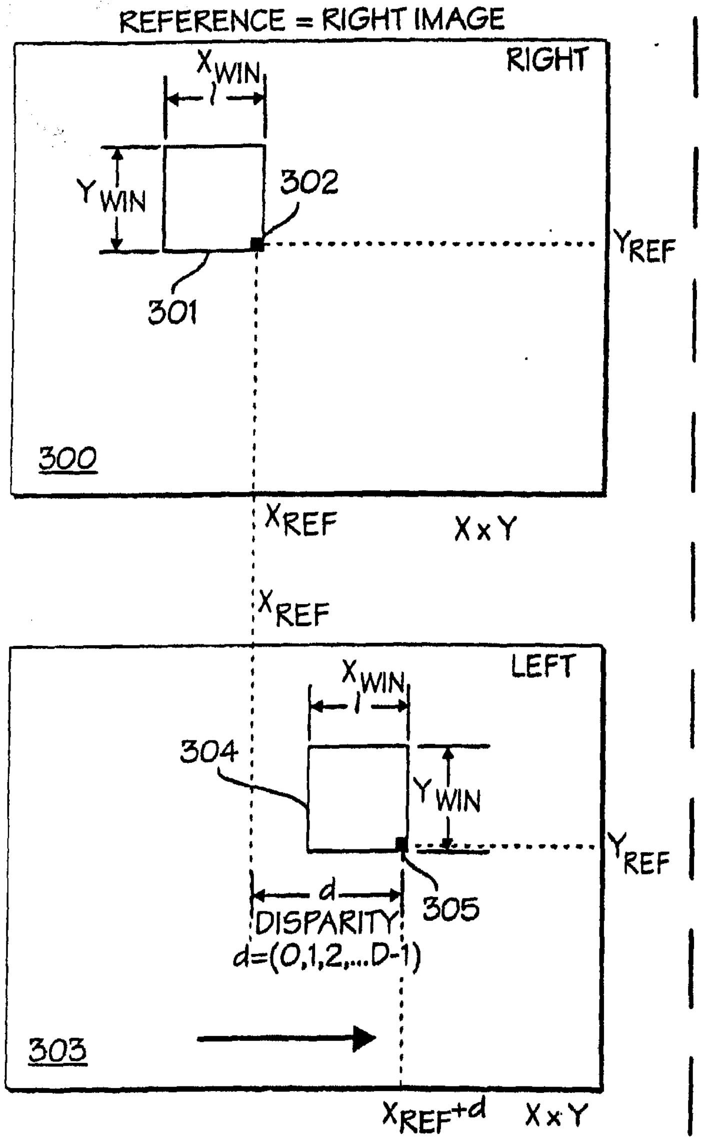

REFERENCE = RIGHT IMAGE
RIGHT
X_{WIN}
Y_{WIN}
302
301
Y_{REF}
300
X_{REF}
X x Y
X_{REF}
LEFT
X_{WIN}
304
Y_{WIN}
Y_{REF}
d
DISPARITY
d=(0,1,2,...D-1)
305
303
X_{REF}+d
X x Y

FIG. 5(A)

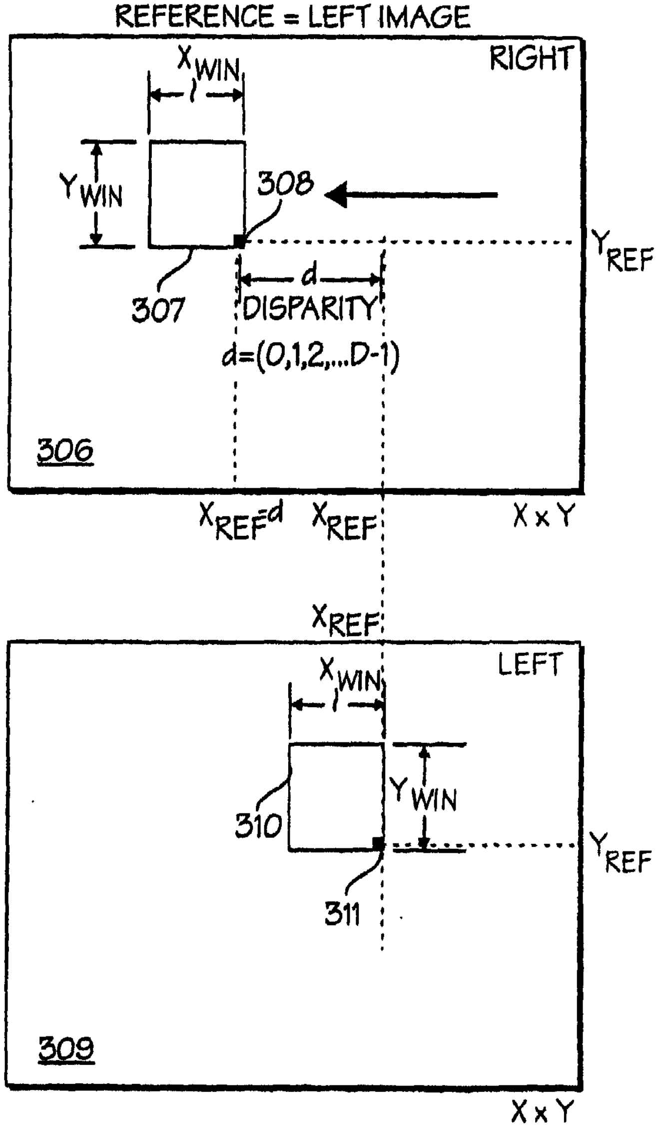

REFERENCE = LEFT IMAGE
RIGHT
X_{WIN}
Y_{WIN}
308
307
Y_{REF}
d
DISPARITY
d=(0,1,2,...D-1)
306
X_{REF}-d
X_{REF}
X x Y
X_{REF}
LEFT
X_{WIN}
310
Y_{WIN}
Y_{REF}
311
309
X x Y

FIG. 5(B)

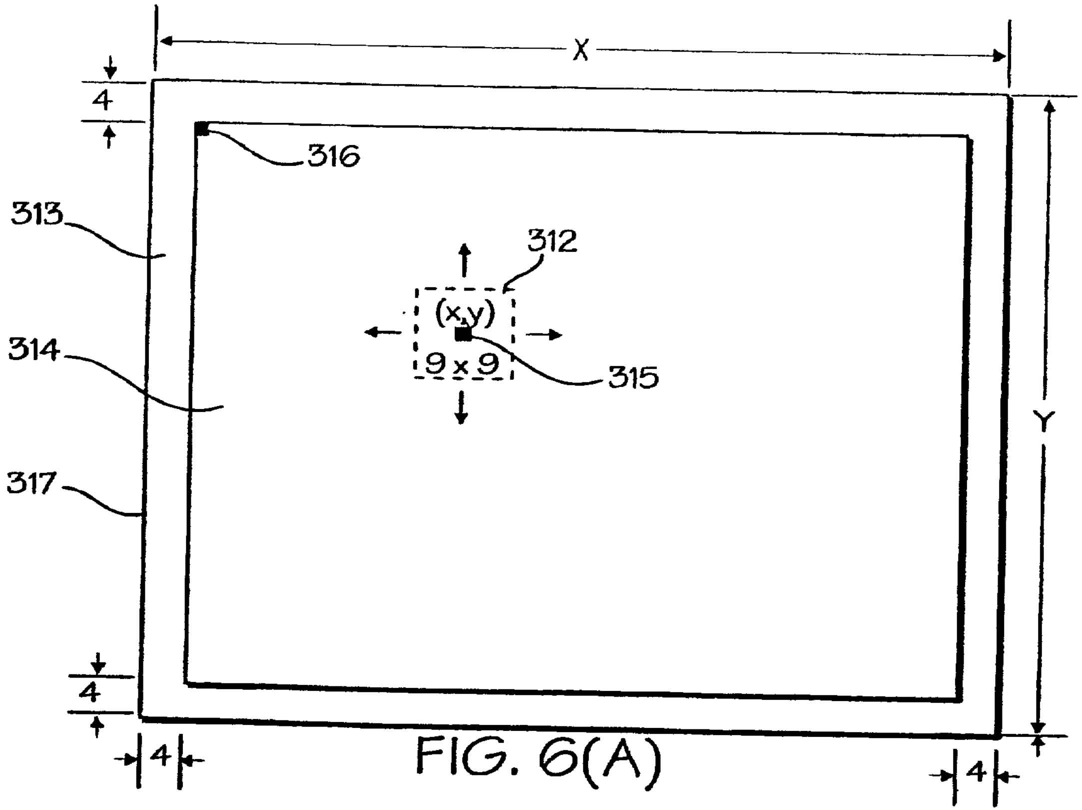

X
4
316
313
312
(x,y)
9 x 9
315
314
317
Y
4
4
4

FIG. 6(A)

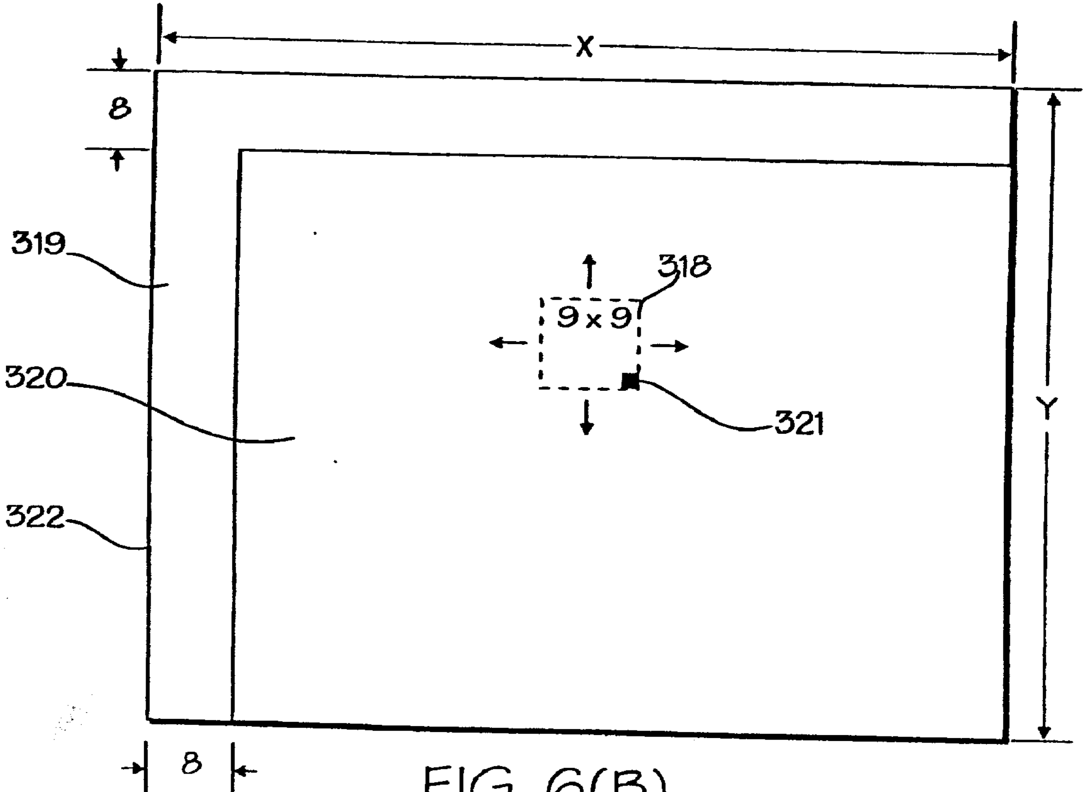
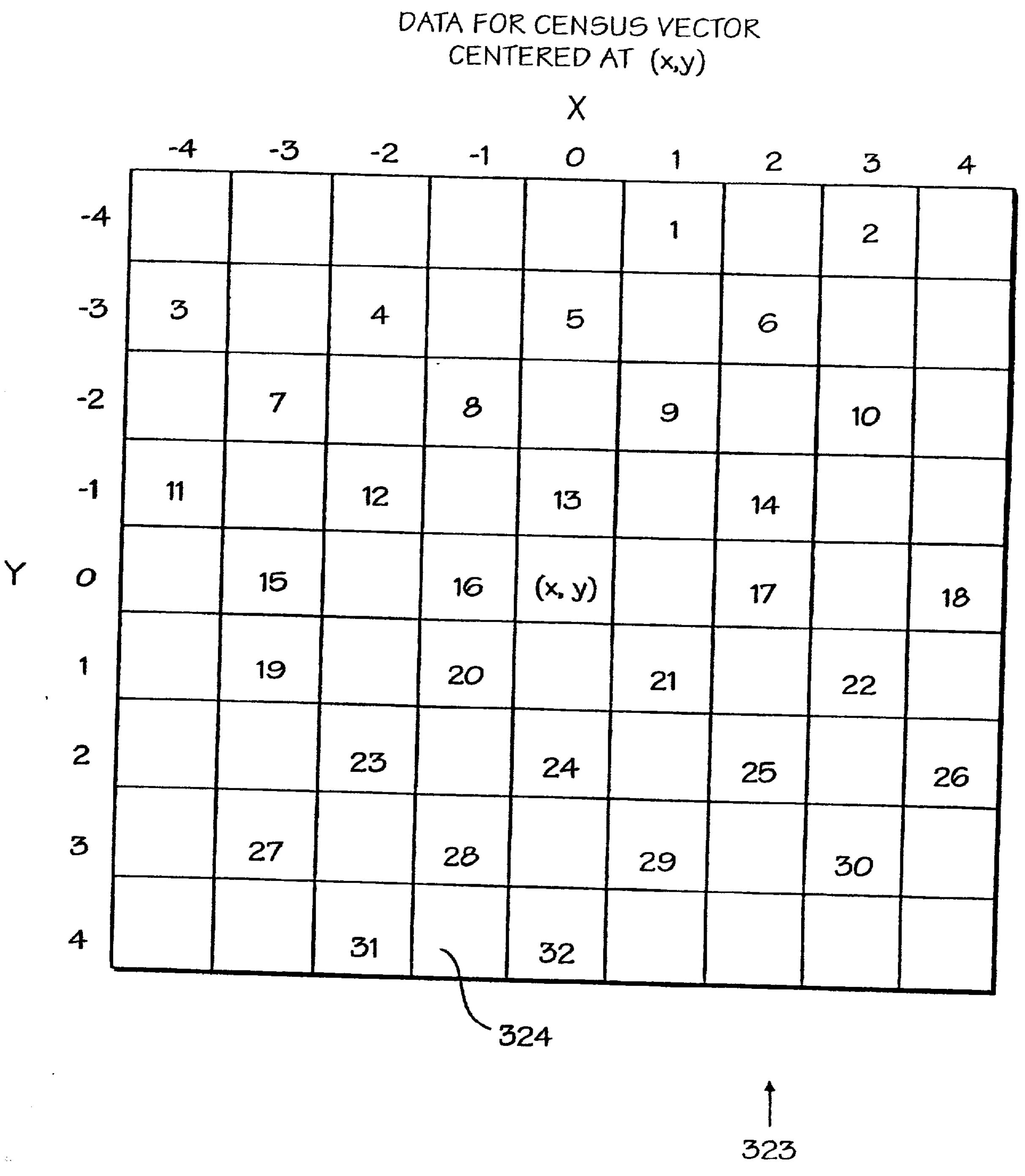

X
8
319
318
9 x 9
320
321
322
Y
8

FIG. 6(B)

DATA FOR CENSUS VECTOR
CENTERED AT (x,y)



Y \ X	-4	-3	-2	-1	0	1	2	3	4
-4						1		2	
-3	3		4		5		6		
-2		7		8		9		10	
-1	11		12		13		14		
0		15		16	(x, y)		17		18
1		19		20		21		22	
2			23		24		25		26
3		27		28		29		30	
4			31		32				

Fig. 7

Fig. 8(A)

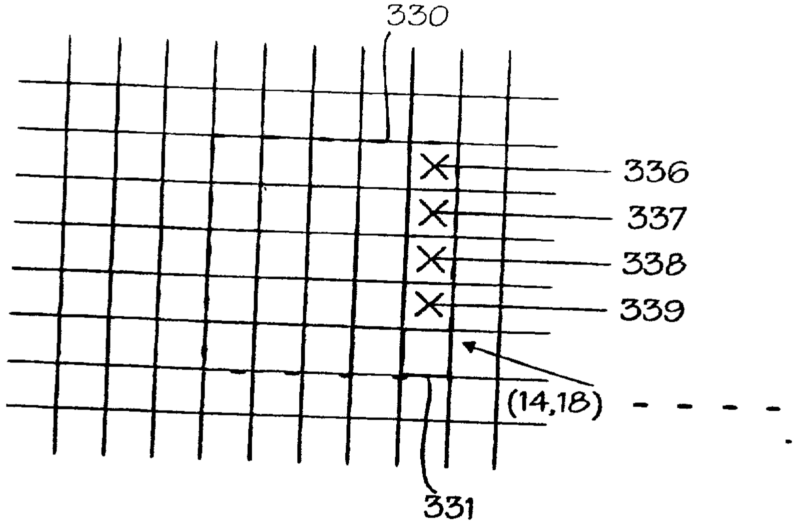


Fig. 8(B)

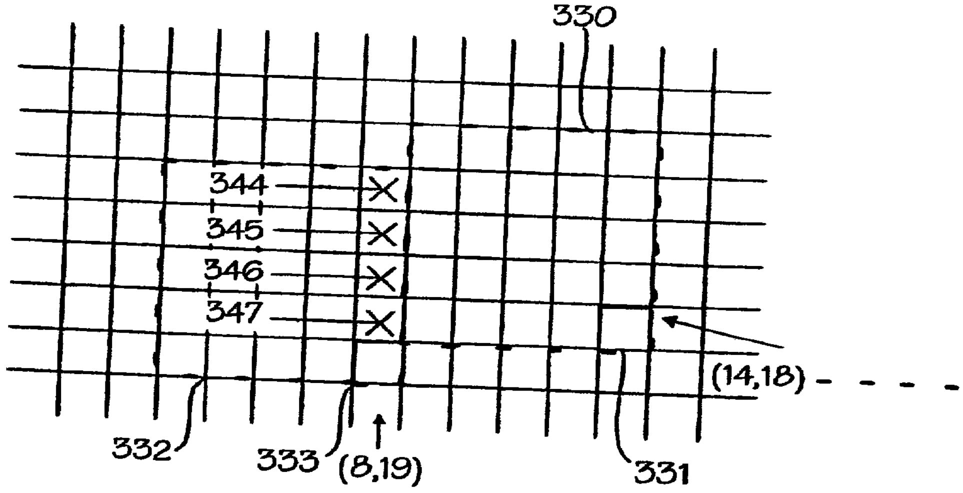


Fig. 8(C)

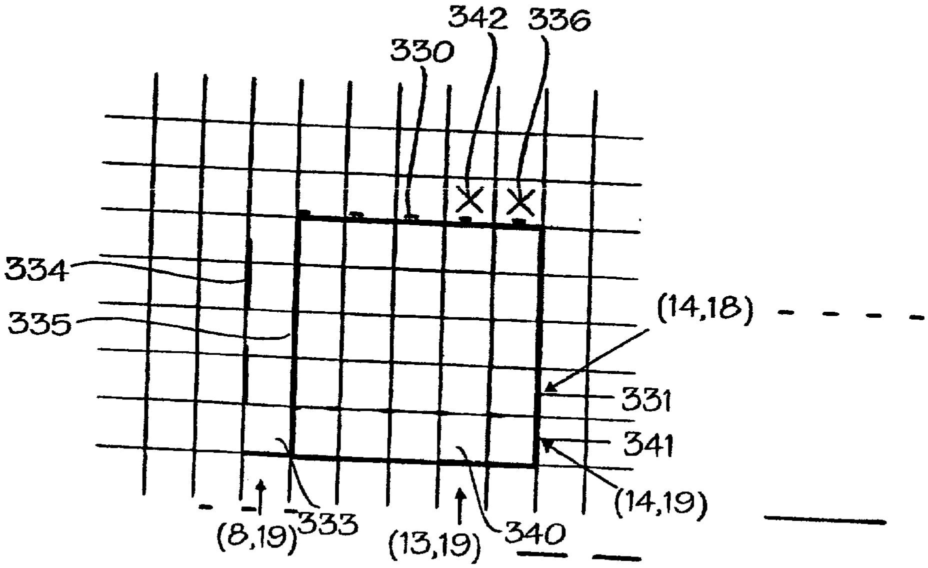


Fig. 9(A)

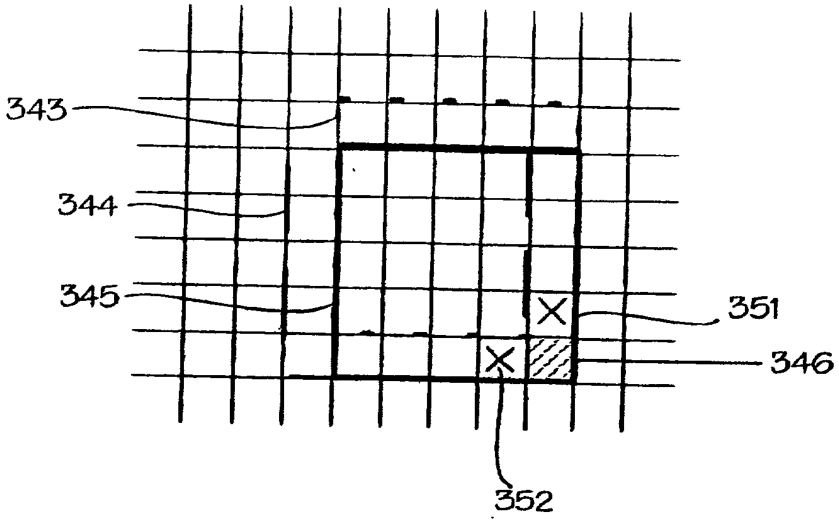


Fig. 9(B)

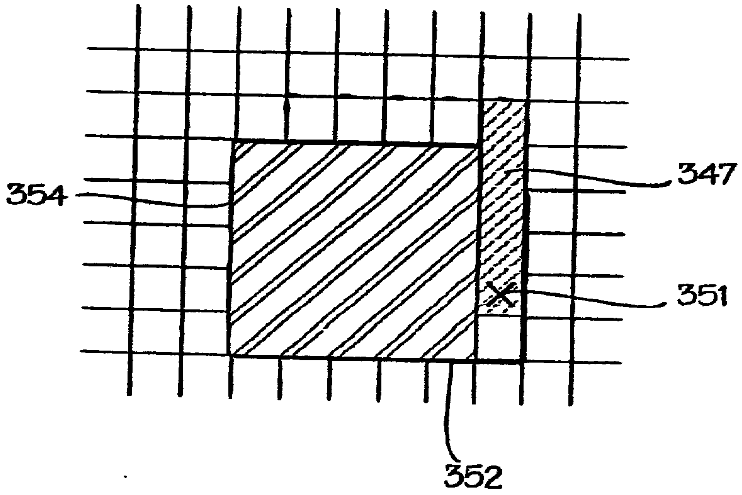
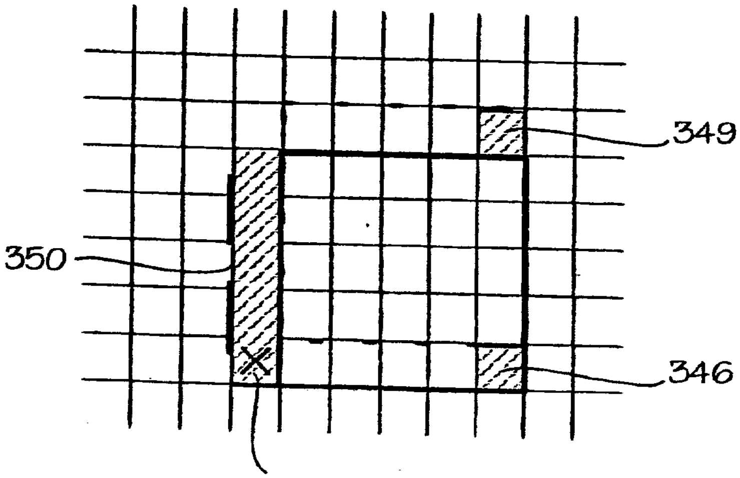


Fig. 9(C)



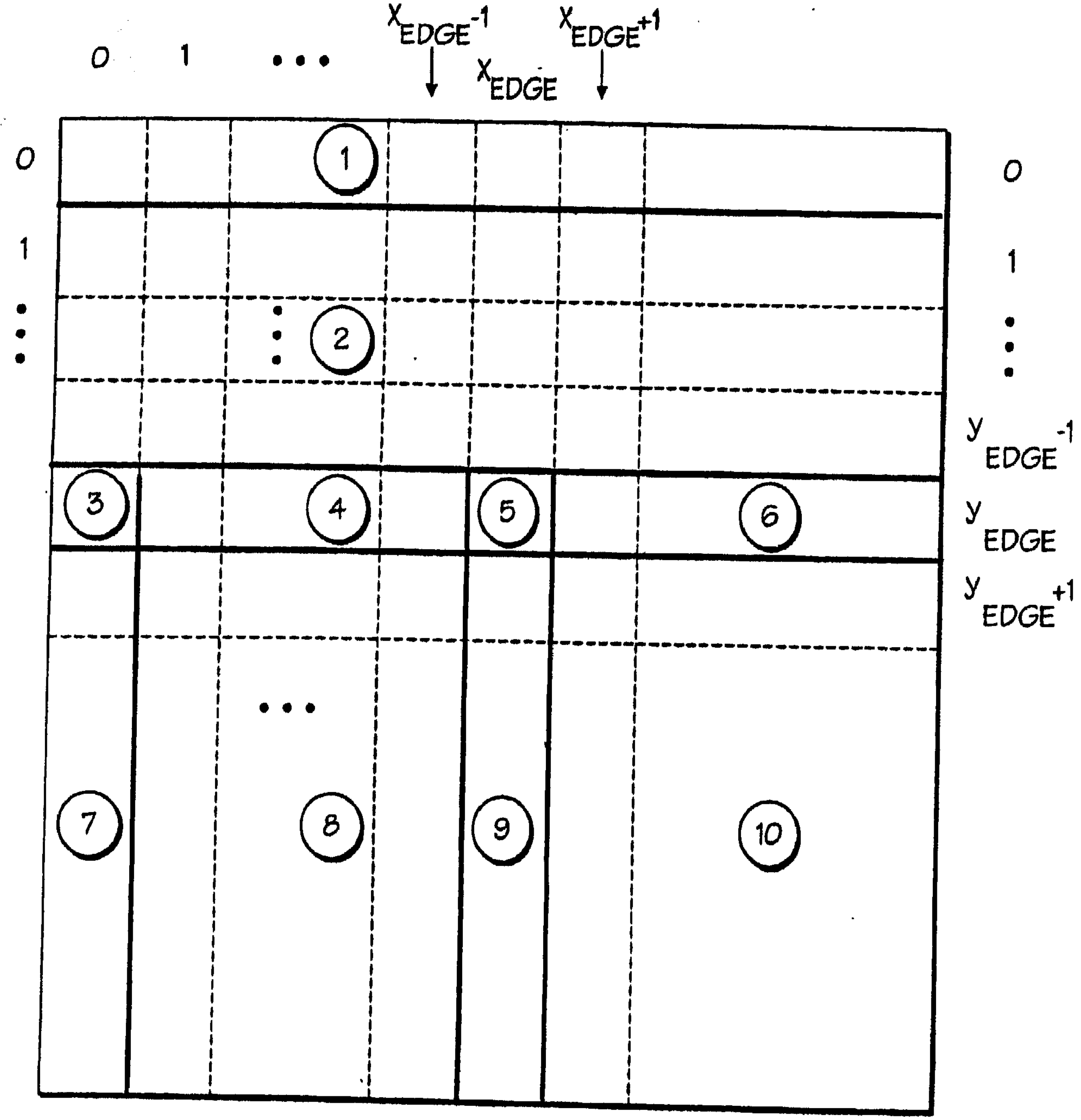

0
1
• • •
$x_{EDGE}-1$
x_{EDGE}
$x_{EDGE}+1$
0
1
• • •
0
1
• • •
$y_{EDGE}-1$
y_{EDGE}
$y_{EDGE}+1$
①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
• • •
• • •

Fig. 10A

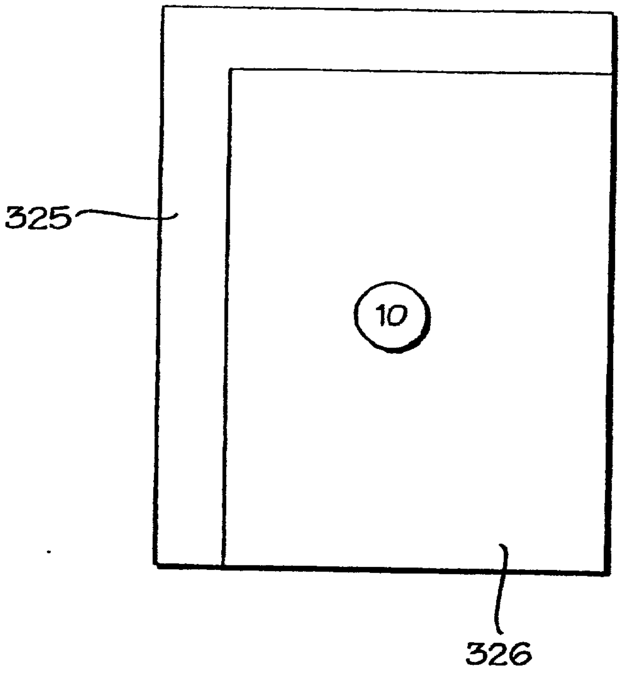


Fig. 10(B)

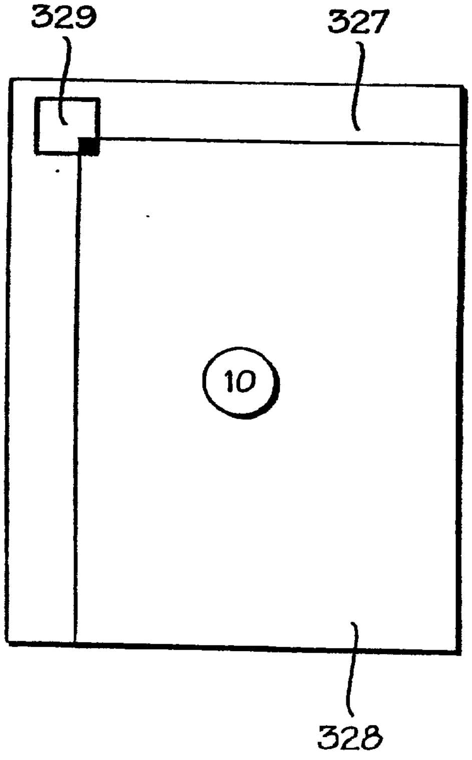


Fig. 10(C)

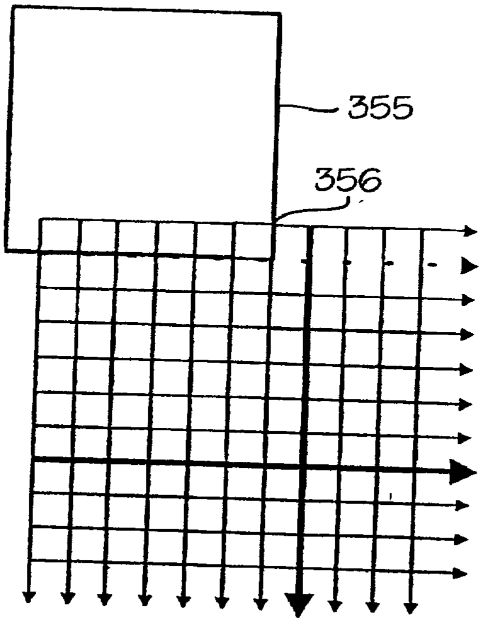


Fig. 11(A)

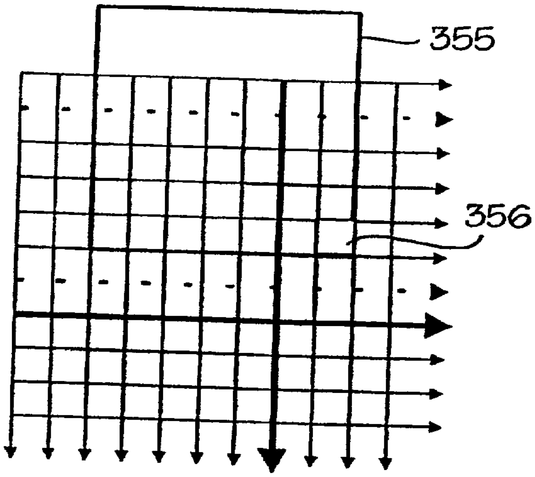


Fig. 11(B)

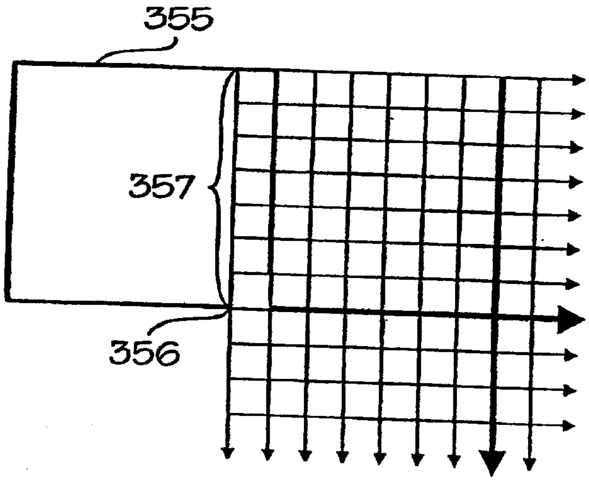


Fig. 11(C)

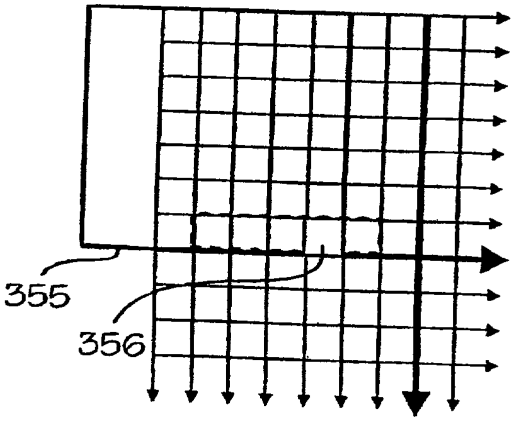


Fig. 11(D)

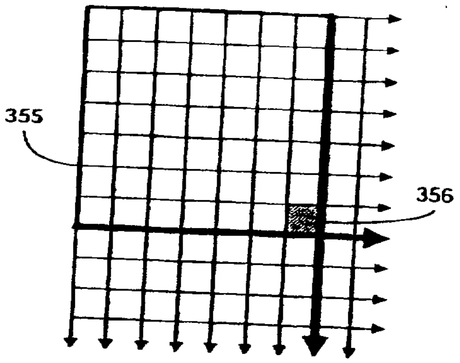


Fig. 11 (E)

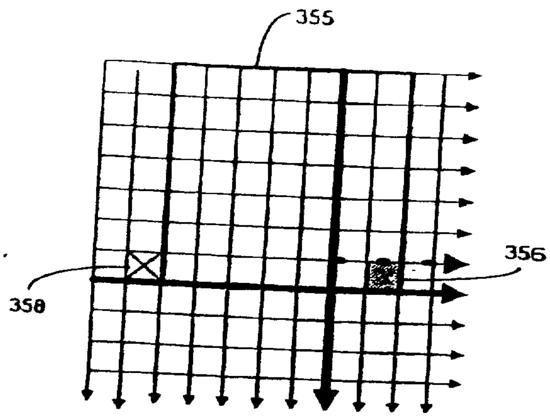


Fig. 11 (F)

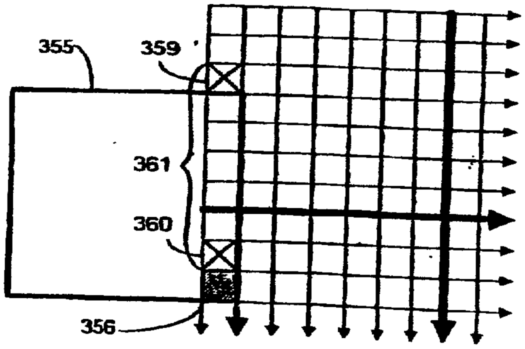


Fig. 11 (G)

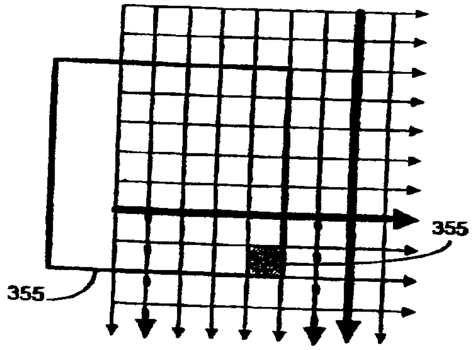


Fig. 11 (H)

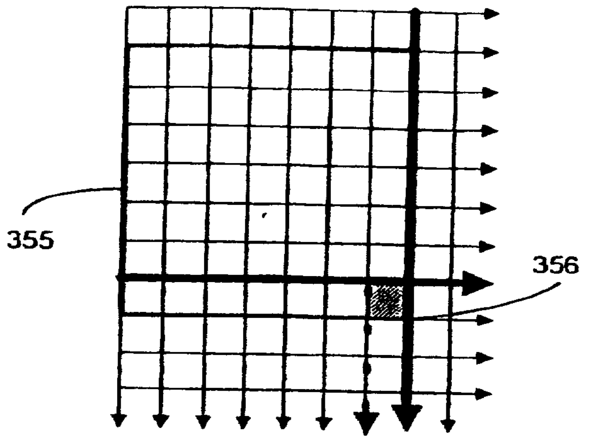


Fig. 11 (I)

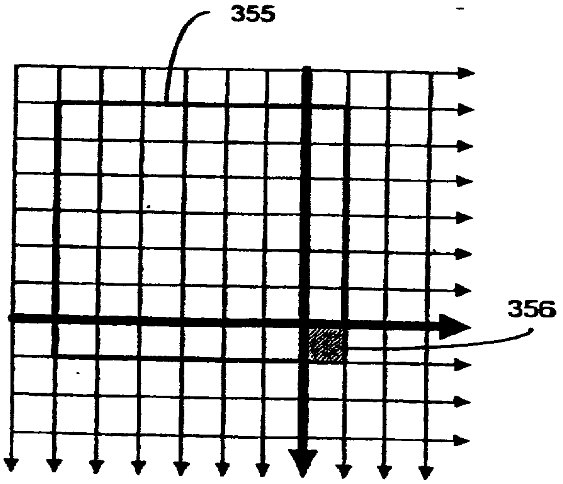


Fig. 11 (J)

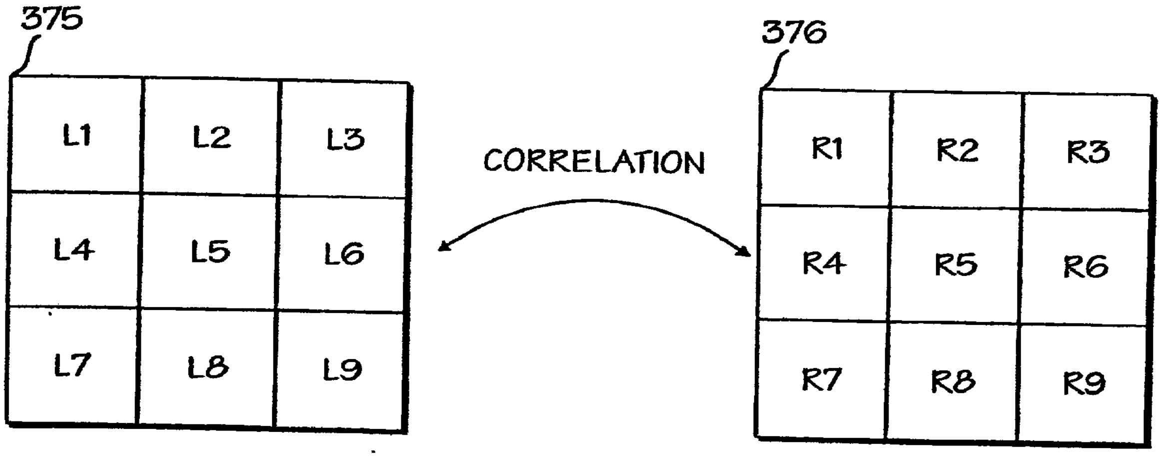

375
L1
L2
L3
L4
L5
L6
L7
L8
L9
CORRELATION
376
R1
R2
R3
R4
R5
R6
R7
R8
R9

Fig. 12

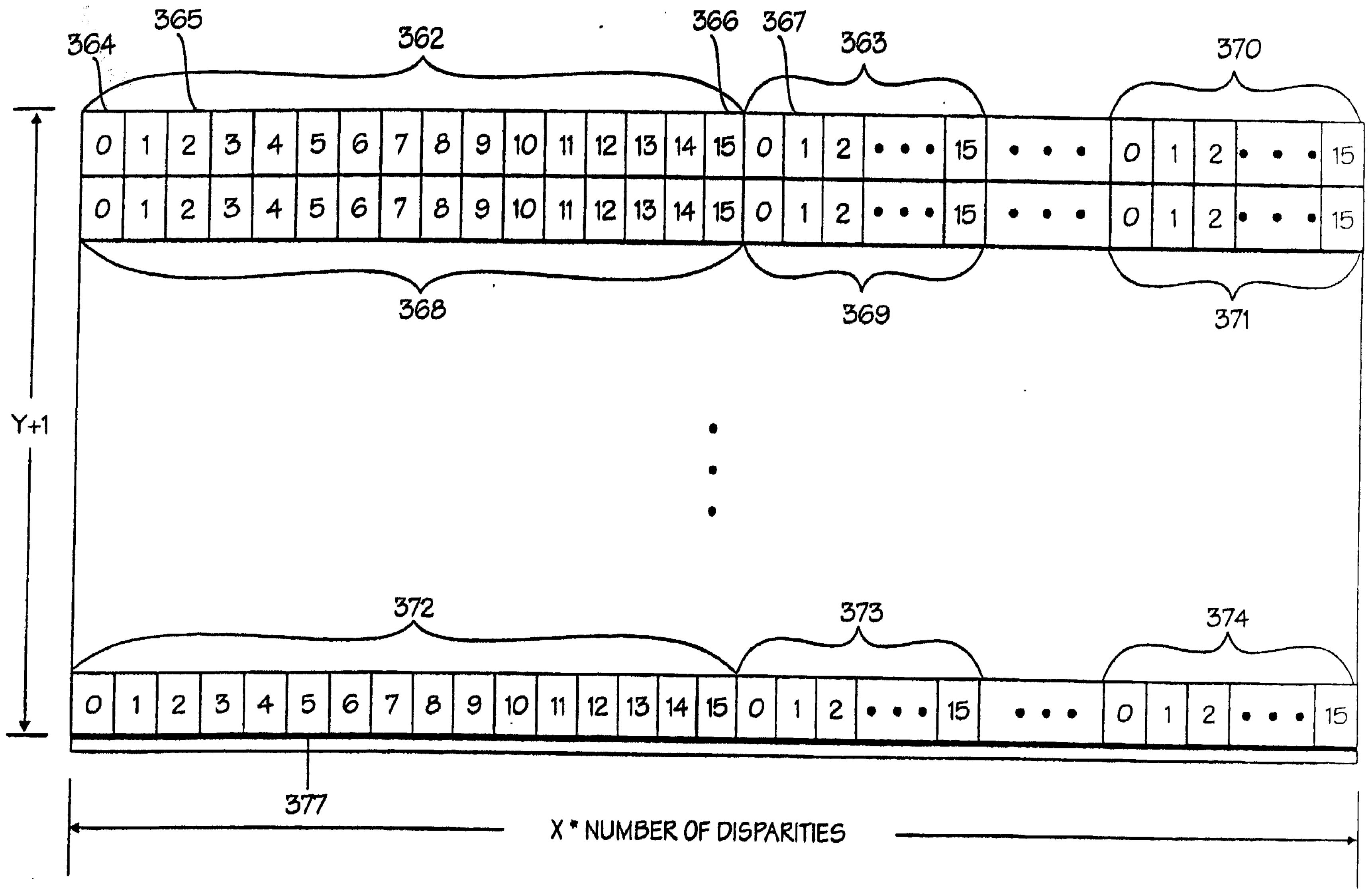
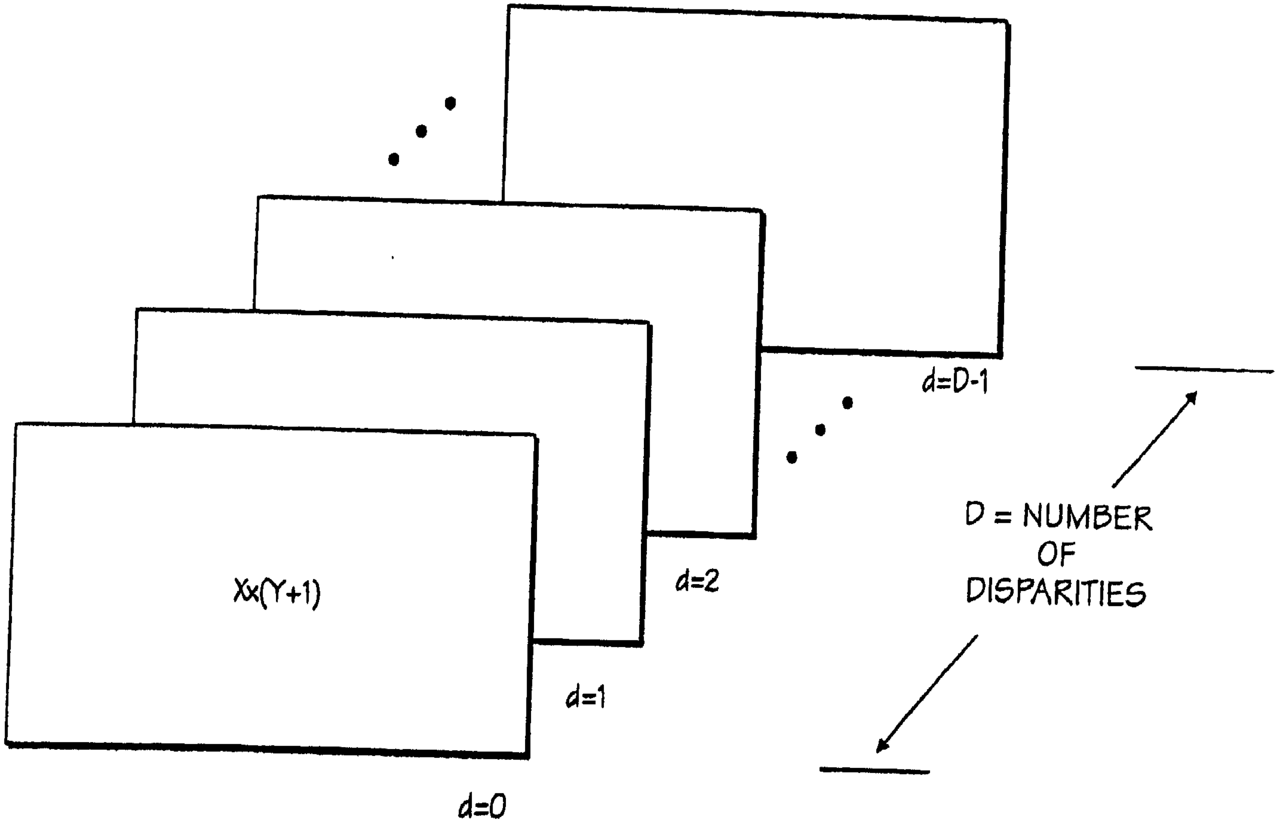

364
365
362
366
367
363
370
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0 1 2 • • • 15 • • • 0 1 2 • • • 15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0 1 2 • • • 15 • • • 0 1 2 • • • 15
368
369
371
Y+1
372
373
374
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0 1 2 • • • 15 • • • 0 1 2 • • • 15
377
X * NUMBER OF DISPARITIES

Fig. 13A



(B)

Fig. 13B

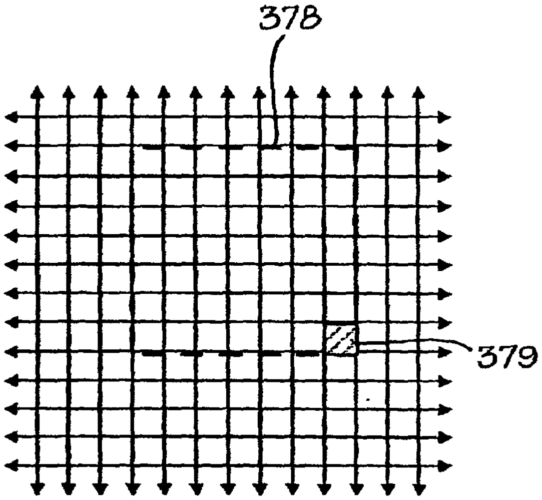


FIG. 14(A)

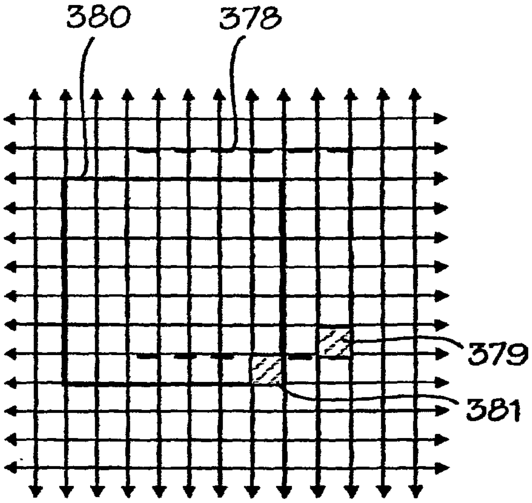


FIG. 14(B)

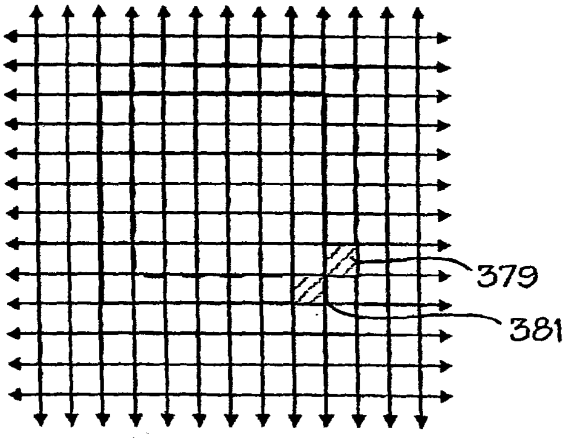


FIG. 14(C)

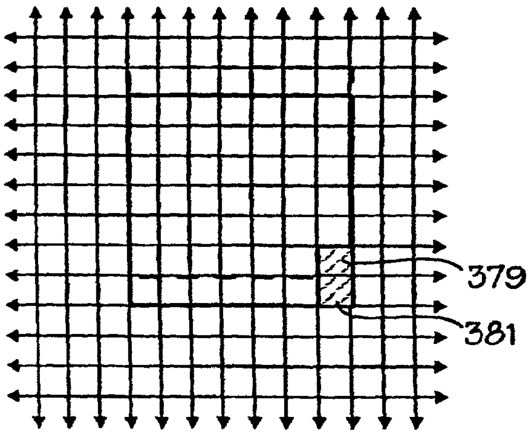


FIG. 14(D)

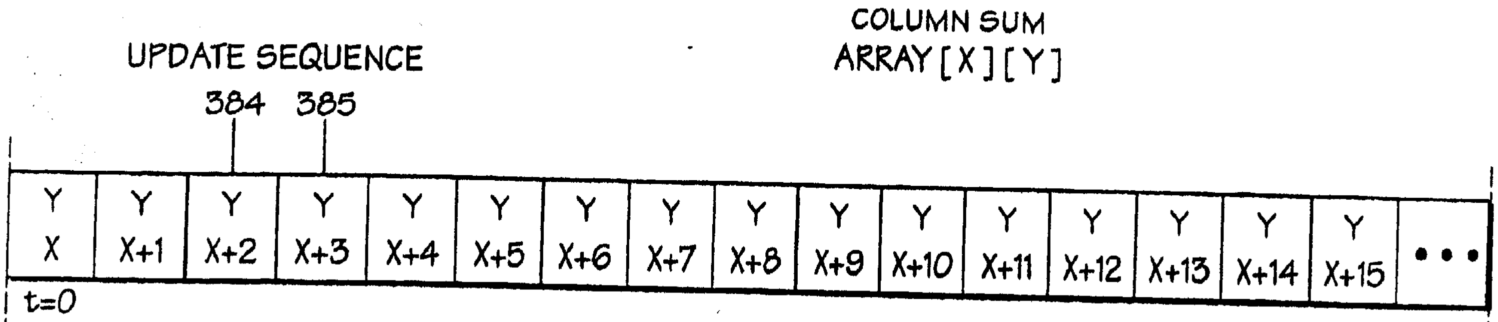


FIG. 15(A)

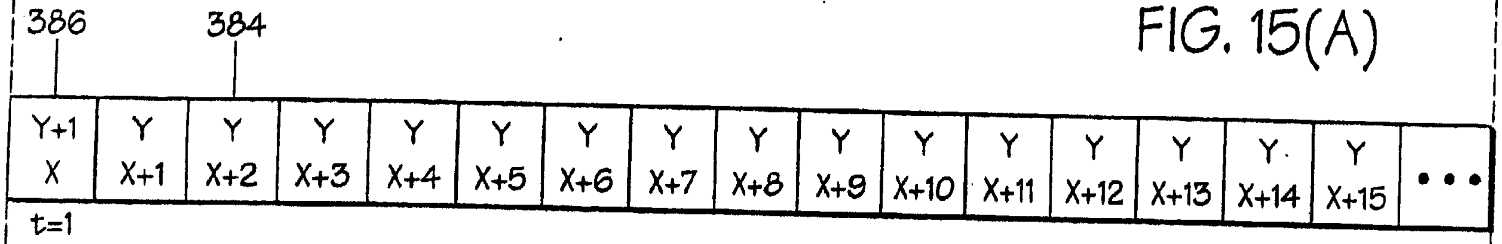


FIG. 15(B)

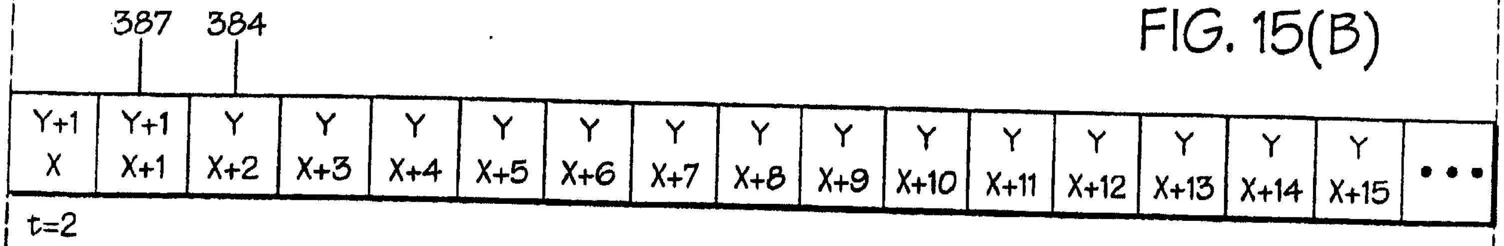


FIG. 15(C)

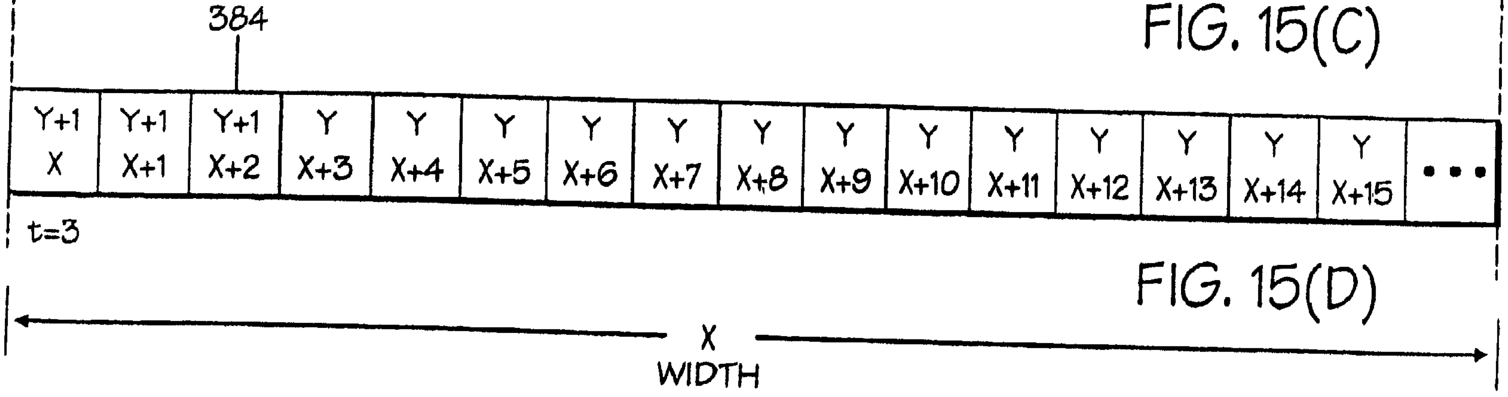


FIG. 15(D)

RIGHT IMAGE = REFERENCE
LEFT IMAGE RIGHT IMAGE

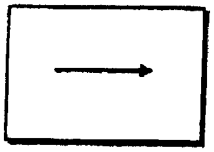


Fig. 16A

Fig. 16B

RIGHT IMAGE = REFERENCE
LEFT IMAGE RIGHT IMAGE

Fig. 16C

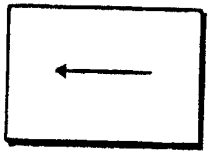


Fig. 16D

CENSUS VECTORS
LEFT IMAGE

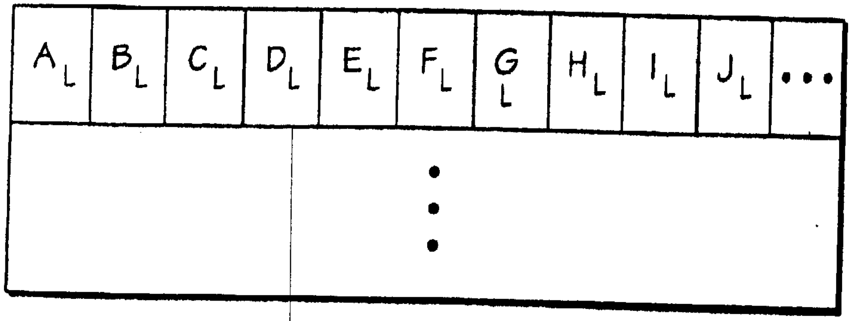


Fig. 16E

CENSUS VECTORS
RIGHT IMAGE

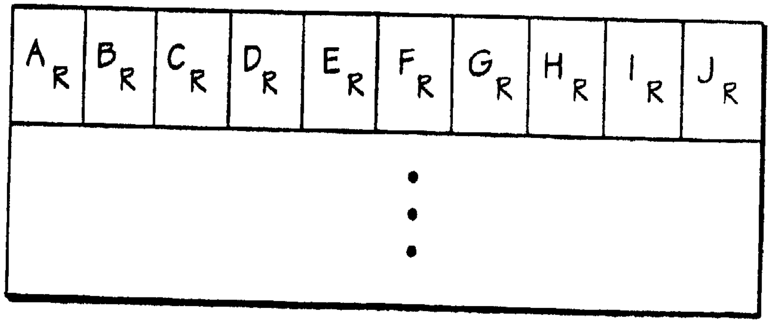


Fig. 16F

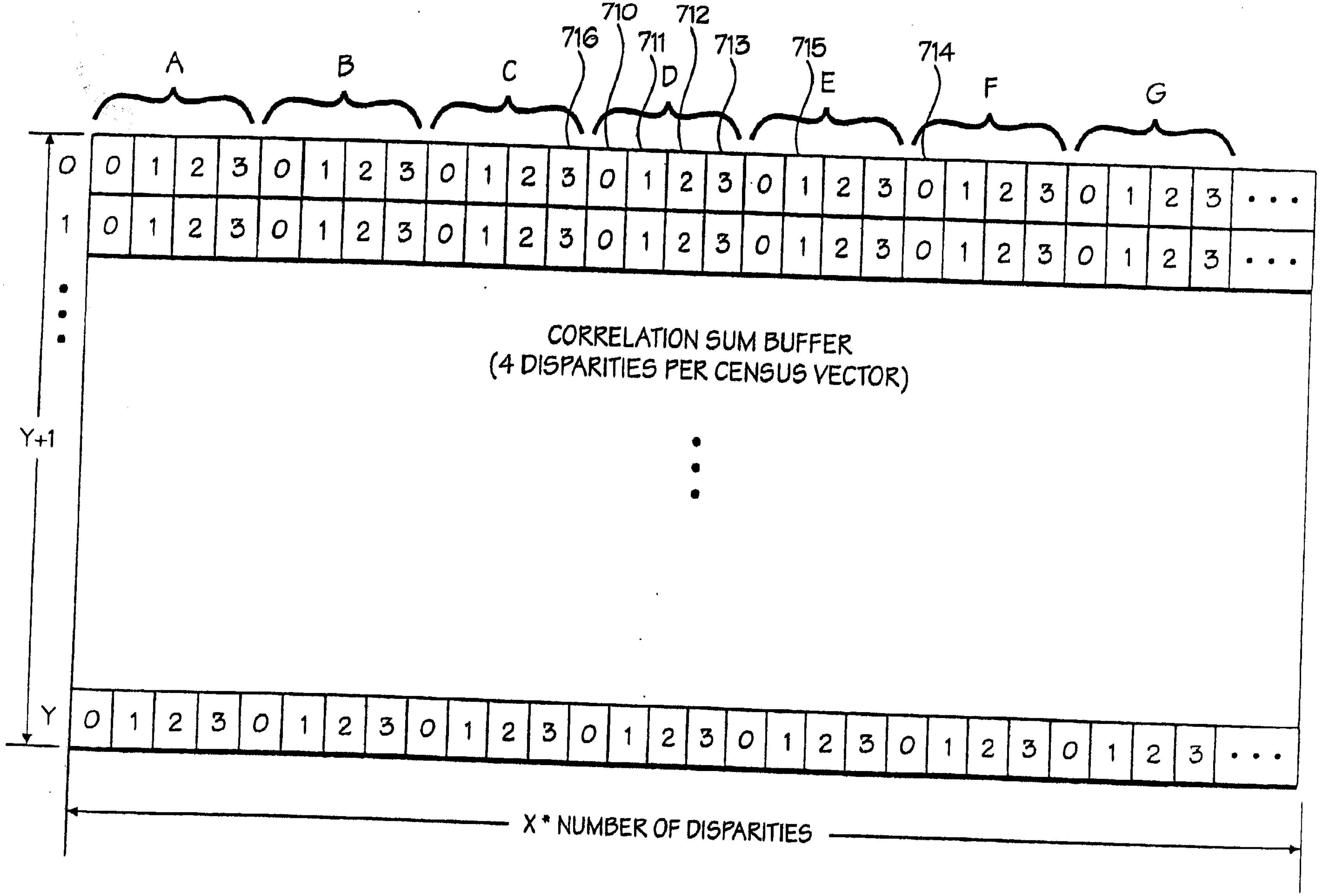

A
B
C
716
710
711
D
712
713
715
E
714
F
G
0
1
Y
Y+1
0 1 2 3 0 1 2 3 0 1 2 3 0 1 2 3 0 1 2 3 0 1 2 3 0 1 2 3 . . .
CORRELATION SUM BUFFER
(4 DISPARITIES PER CENSUS VECTOR)
X * NUMBER OF DISPARITIES

Fig. 16G

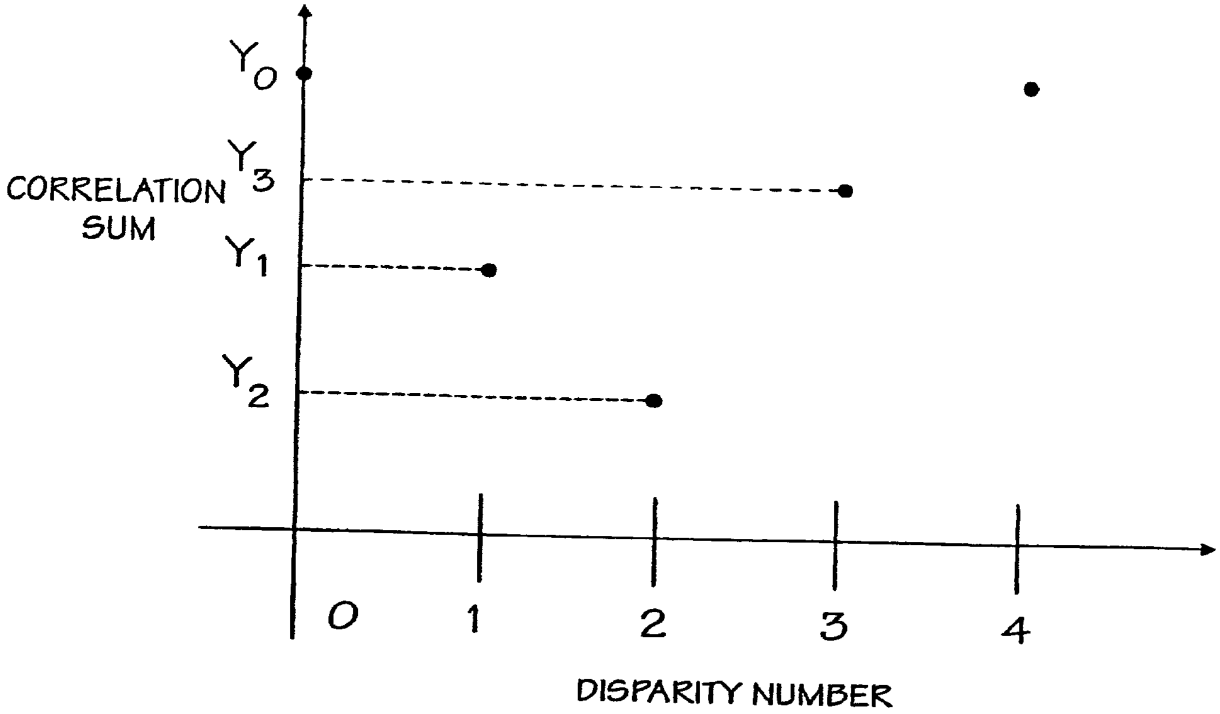


FIG. 17(A)

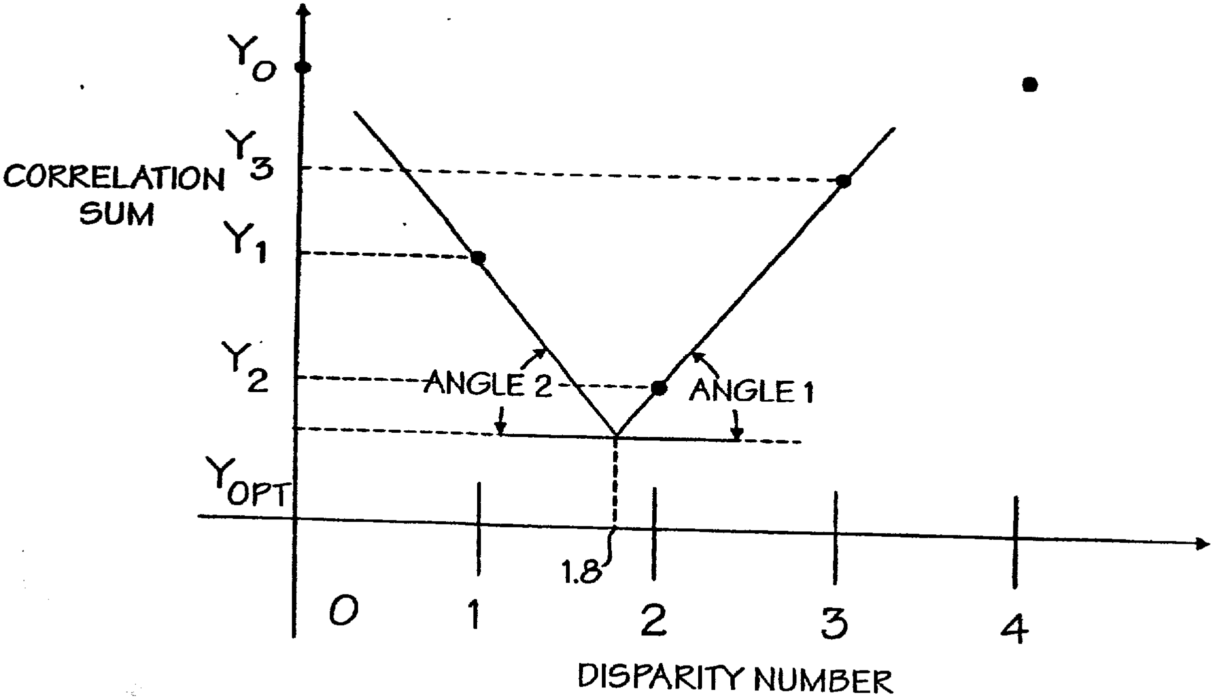


FIG. 17(B)

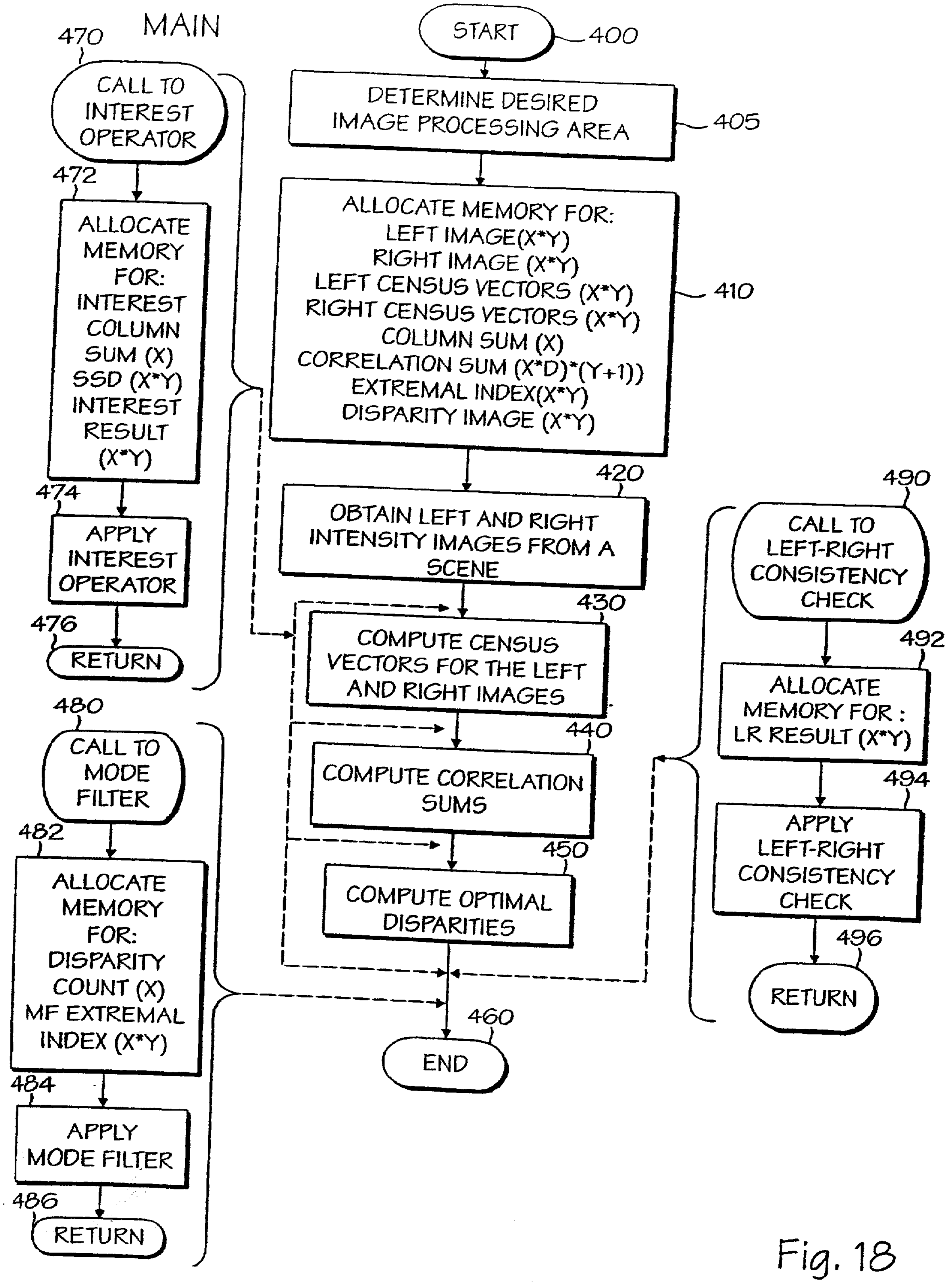

MAIN
START
400
DETERMINE DESIRED IMAGE PROCESSING AREA
405
ALLOCATE MEMORY FOR:
LEFT IMAGE(X*Y)
RIGHT IMAGE (X*Y)
LEFT CENSUS VECTORS (X*Y)
RIGHT CENSUS VECTORS (X*Y)
COLUMN SUM (X)
CORRELATION SUM (X*D)*(Y+1))
EXTREMAL INDEX(X*Y)
DISPARITY IMAGE (X*Y)
410
420
OBTAIN LEFT AND RIGHT INTENSITY IMAGES FROM A SCENE
430
COMPUTE CENSUS VECTORS FOR THE LEFT AND RIGHT IMAGES
440
COMPUTE CORRELATION SUMS
450
COMPUTE OPTIMAL DISPARITIES
460
END
470
CALL TO INTEREST OPERATOR
472
ALLOCATE MEMORY FOR: INTEREST COLUMN SUM (X) SSD (X*Y) INTEREST RESULT (X*Y)
474
APPLY INTEREST OPERATOR
476
RETURN
480
CALL TO MODE FILTER
482
ALLOCATE MEMORY FOR: DISPARITY COUNT (X) MF EXTREMAL INDEX (X*Y)
484
APPLY MODE FILTER
486
RETURN
490
CALL TO LEFT-RIGHT CONSISTENCY CHECK
492
ALLOCATE MEMORY FOR : LR RESULT (X*Y)
494
APPLY LEFT-RIGHT CONSISTENCY CHECK
496
RETURN

Fig. 18

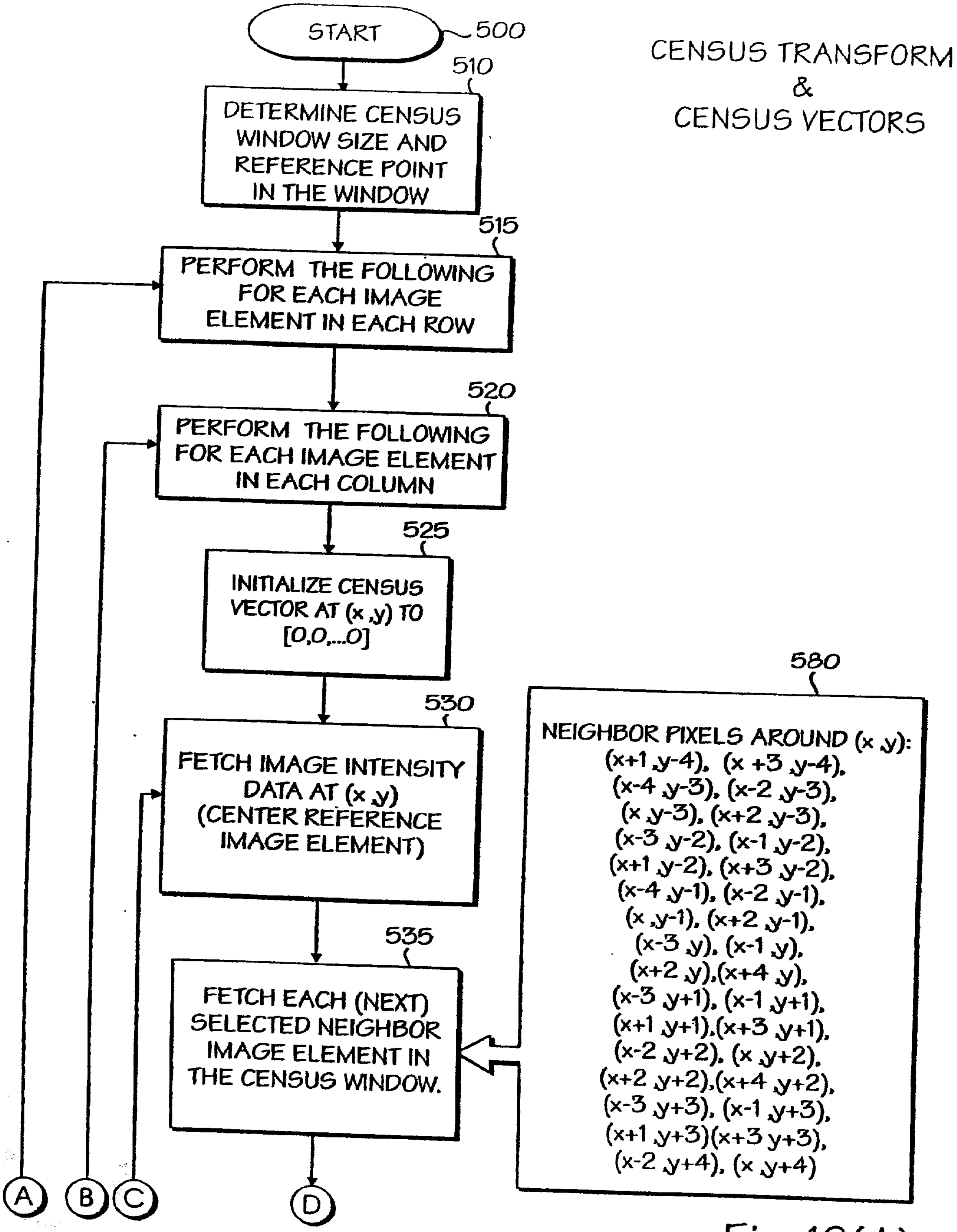

CENSUS TRANSFORM
&
CENSUS VECTORS
START
500
510
DETERMINE CENSUS WINDOW SIZE AND REFERENCE POINT IN THE WINDOW
515
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT IN EACH ROW
520
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT IN EACH COLUMN
525
INITIALIZE CENSUS VECTOR AT (x ,y) TO [0,0,...0]
530
FETCH IMAGE INTENSITY DATA AT (x ,y) (CENTER REFERENCE IMAGE ELEMENT)
535
FETCH EACH (NEXT) SELECTED NEIGHBOR IMAGE ELEMENT IN THE CENSUS WINDOW.
580
NEIGHBOR PIXELS AROUND (x ,y):
(x+1 ,y-4), (x +3 ,y-4),
(x-4 ,y-3), (x-2 ,y-3),
(x ,y-3), (x+2 ,y-3),
(x-3 ,y-2), (x-1 ,y-2),
(x+1 ,y-2), (x+3 ,y-2),
(x-4 ,y-1), (x-2 ,y-1),
(x ,y-1), (x+2 ,y-1),
(x-3 ,y), (x-1 ,y),
(x+2 ,y),(x+4 ,y),
(x-3 ,y+1), (x-1 ,y+1),
(x+1 ,y+1),(x+3 ,y+1),
(x-2 ,y+2), (x ,y+2),
(x+2 ,y+2),(x+4 ,y+2),
(x-3 ,y+3), (x-1 ,y+3),
(x+1 ,y+3)(x+3 y+3),
(x-2 ,y+4), (x ,y+4)
A
B
C
D

Fig. 19(A)

CENSUS TRANSFORM
&
CENSUS VECTORS

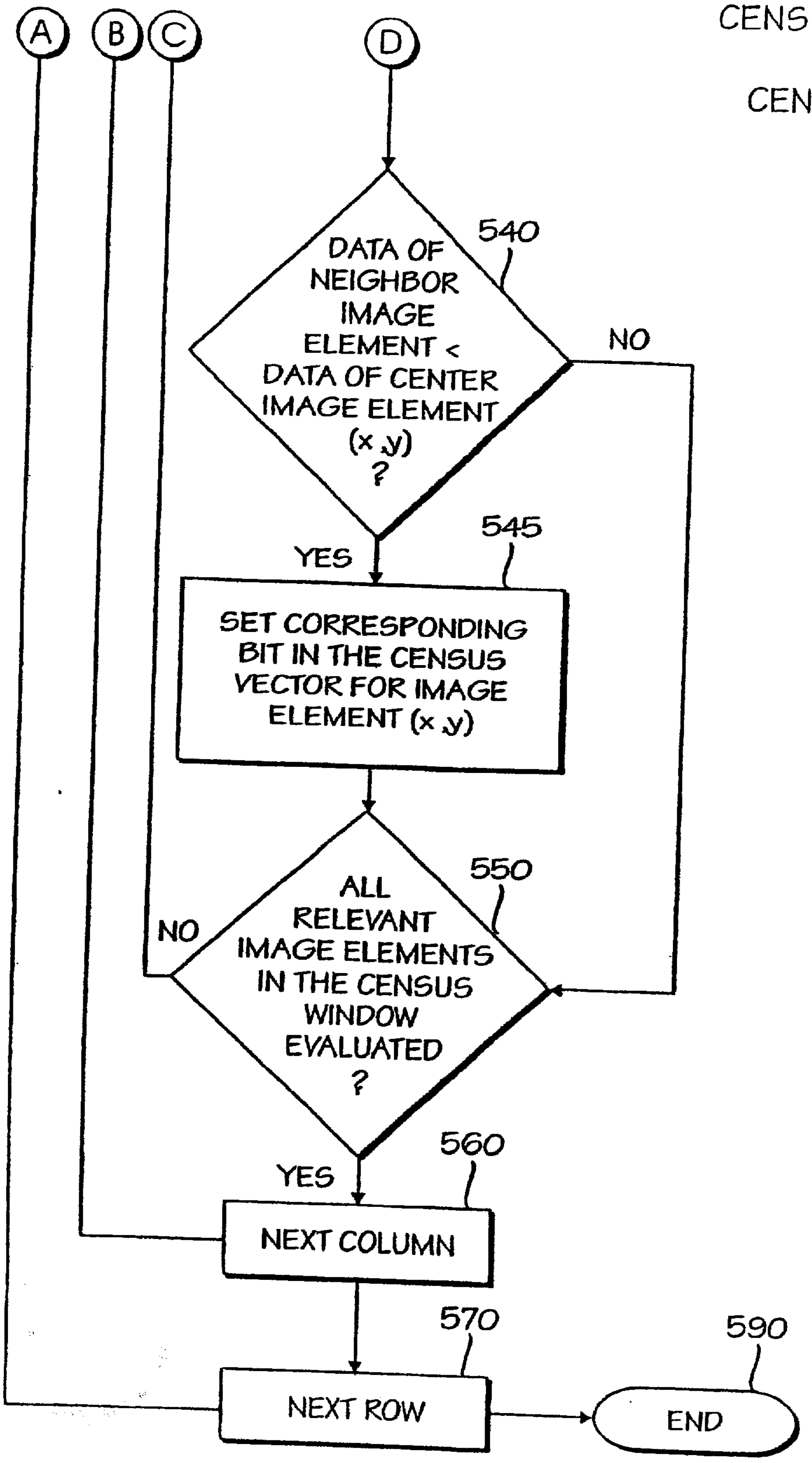


Fig. 19(B)

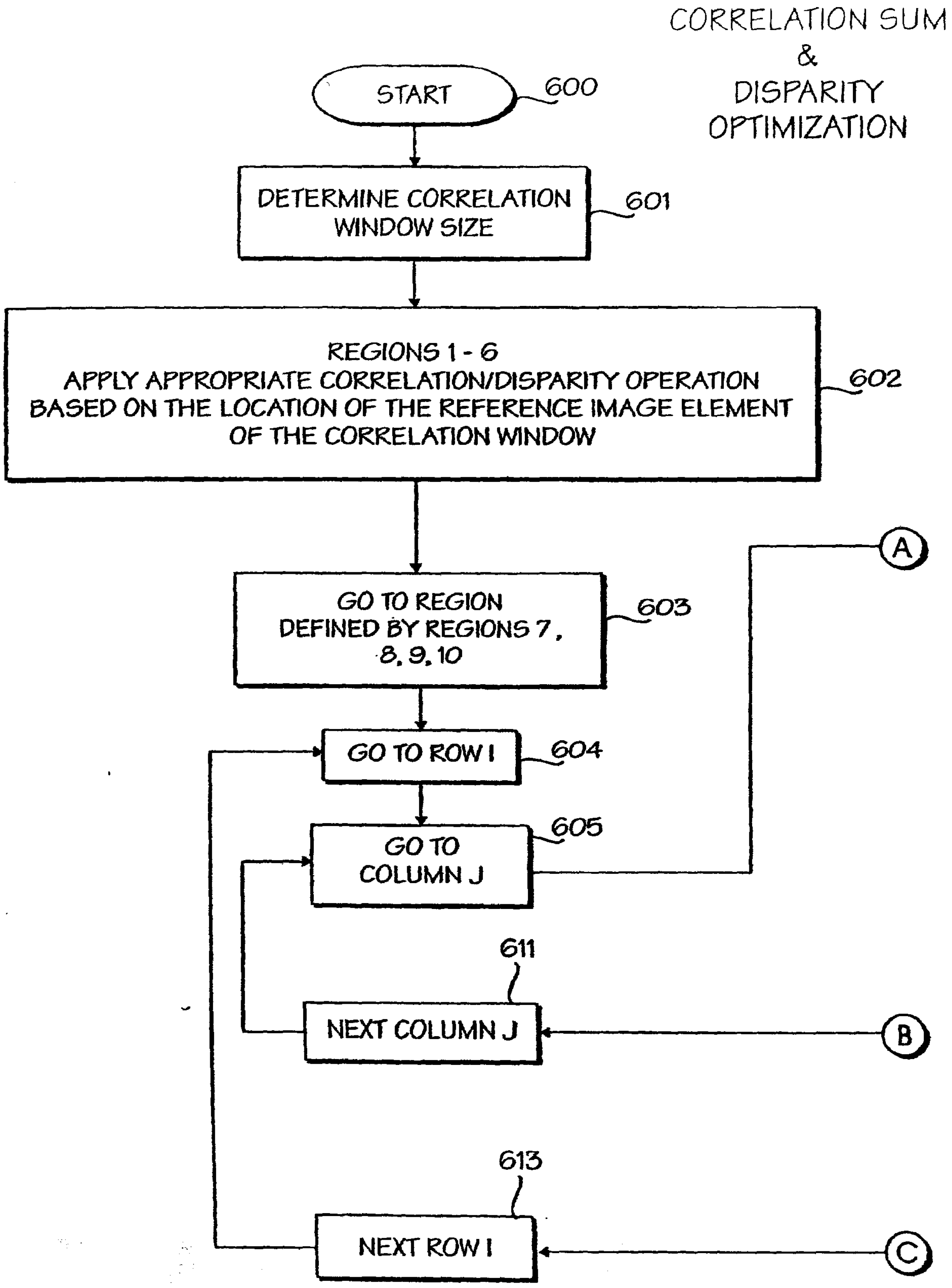

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
START
600
DETERMINE CORRELATION WINDOW SIZE
601
REGIONS 1 - 6
APPLY APPROPRIATE CORRELATION/DISPARITY OPERATION BASED ON THE LOCATION OF THE REFERENCE IMAGE ELEMENT OF THE CORRELATION WINDOW
602
GO TO REGION DEFINED BY REGIONS 7, 8, 9, 10
603
A
GO TO ROW I
604
GO TO COLUMN J
605
611
NEXT COLUMN J
B
613
NEXT ROW I
C

Fig. 20(A)

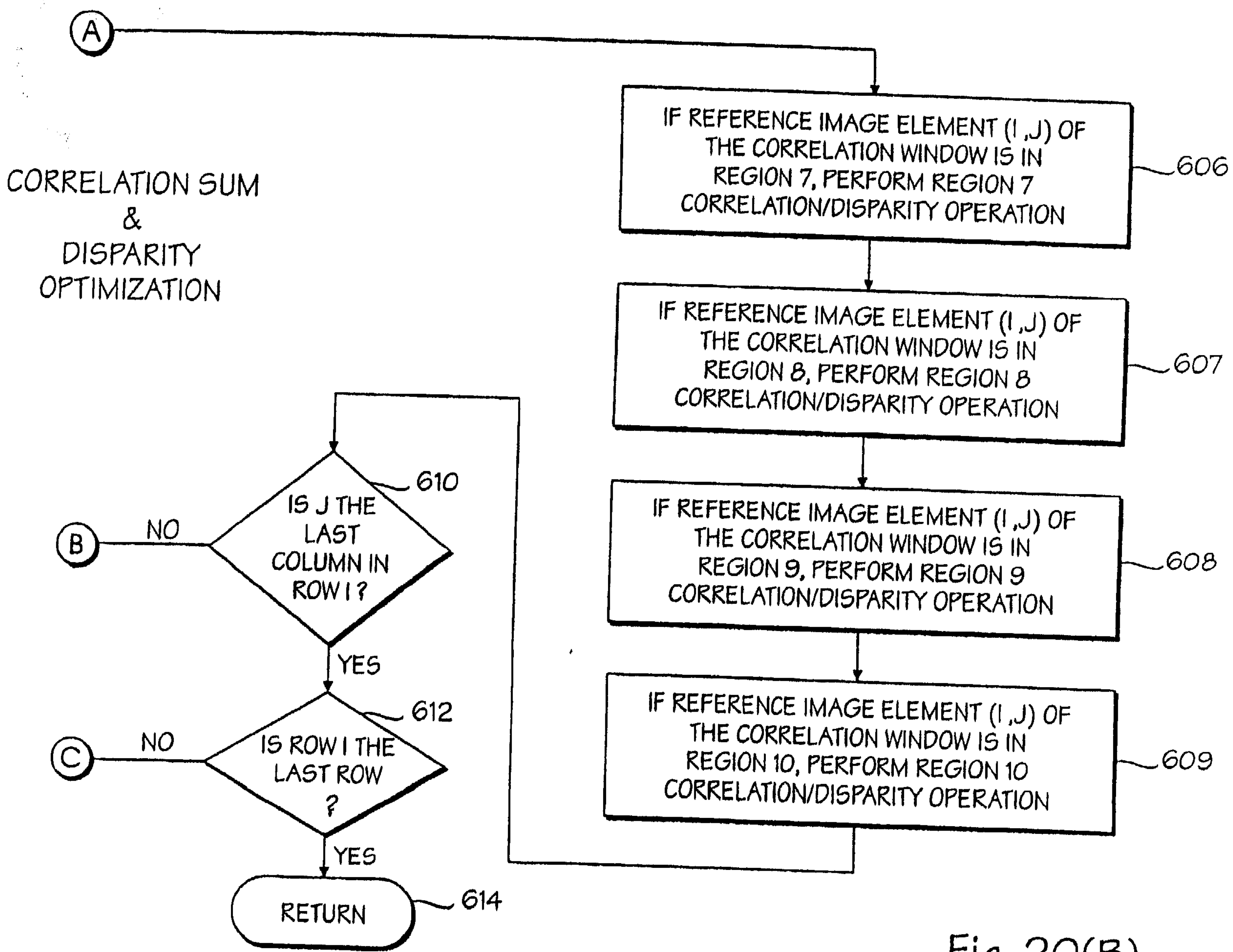

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
A
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 7, PERFORM REGION 7 CORRELATION/DISPARITY OPERATION
606
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 8, PERFORM REGION 8 CORRELATION/DISPARITY OPERATION
607
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 9, PERFORM REGION 9 CORRELATION/DISPARITY OPERATION
608
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 10, PERFORM REGION 10 CORRELATION/DISPARITY OPERATION
609
IS J THE LAST COLUMN IN ROW I ?
610
B
NO
YES
IS ROW I THE LAST ROW ?
612
C
NO
YES
RETURN
614

Fig. 20(B)

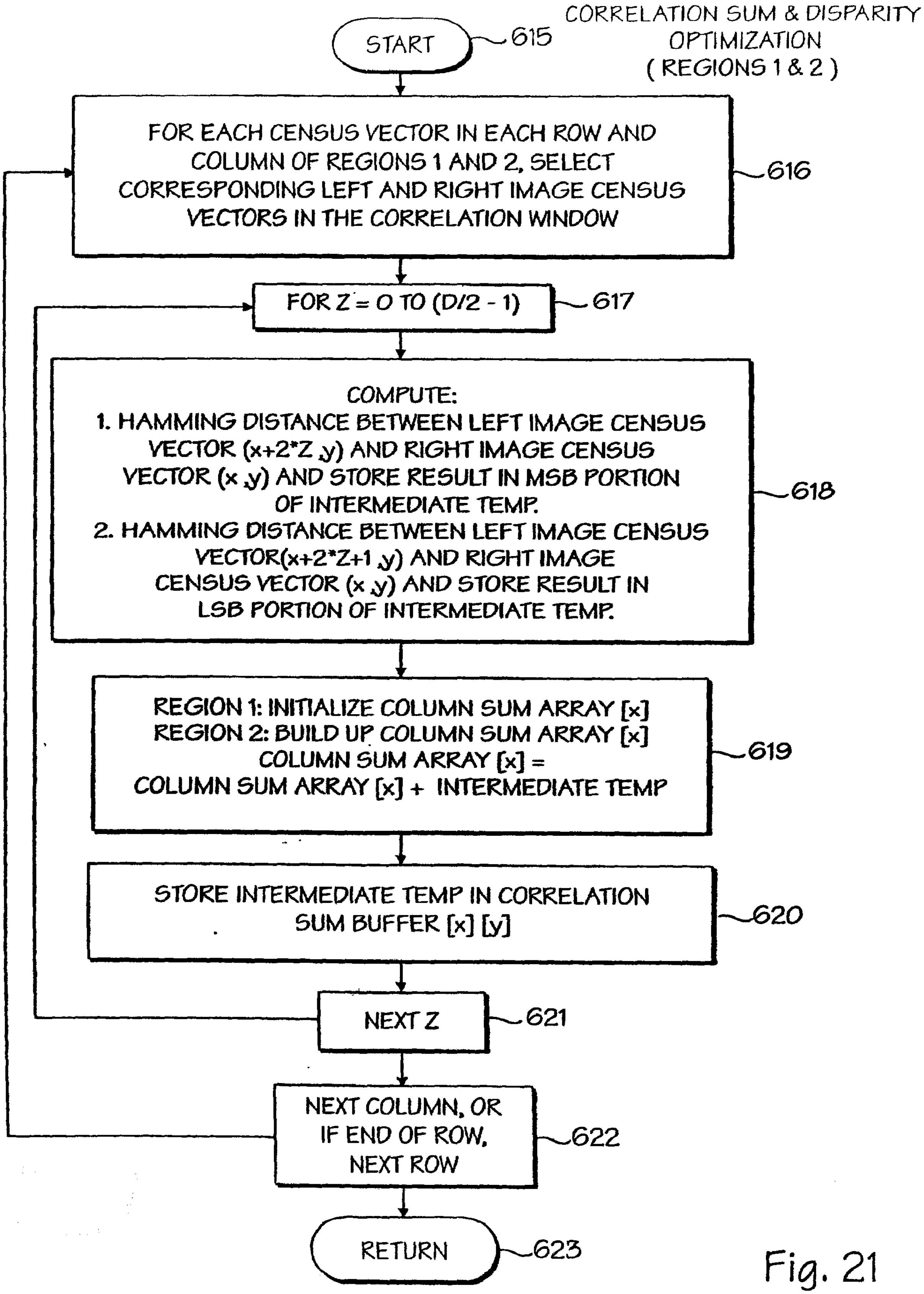

CORRELATION SUM & DISPARITY OPTIMIZATION (REGIONS 1 & 2)
START
615
FOR EACH CENSUS VECTOR IN EACH ROW AND COLUMN OF REGIONS 1 AND 2, SELECT CORRESPONDING LEFT AND RIGHT IMAGE CENSUS VECTORS IN THE CORRELATION WINDOW
616
FOR Z = 0 TO (D/2 - 1)
617
COMPUTE:
1. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*Z ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN MSB PORTION OF INTERMEDIATE TEMP.
2. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR(x+2*Z+1 ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN LSB PORTION OF INTERMEDIATE TEMP.
618
REGION 1: INITIALIZE COLUMN SUM ARRAY [x]
REGION 2: BUILD UP COLUMN SUM ARRAY [x]
COLUMN SUM ARRAY [x] =
COLUMN SUM ARRAY [x] + INTERMEDIATE TEMP
619
STORE INTERMEDIATE TEMP IN CORRELATION SUM BUFFER [x] [y]
620
NEXT Z
621
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
622
RETURN
623

Fig. 21

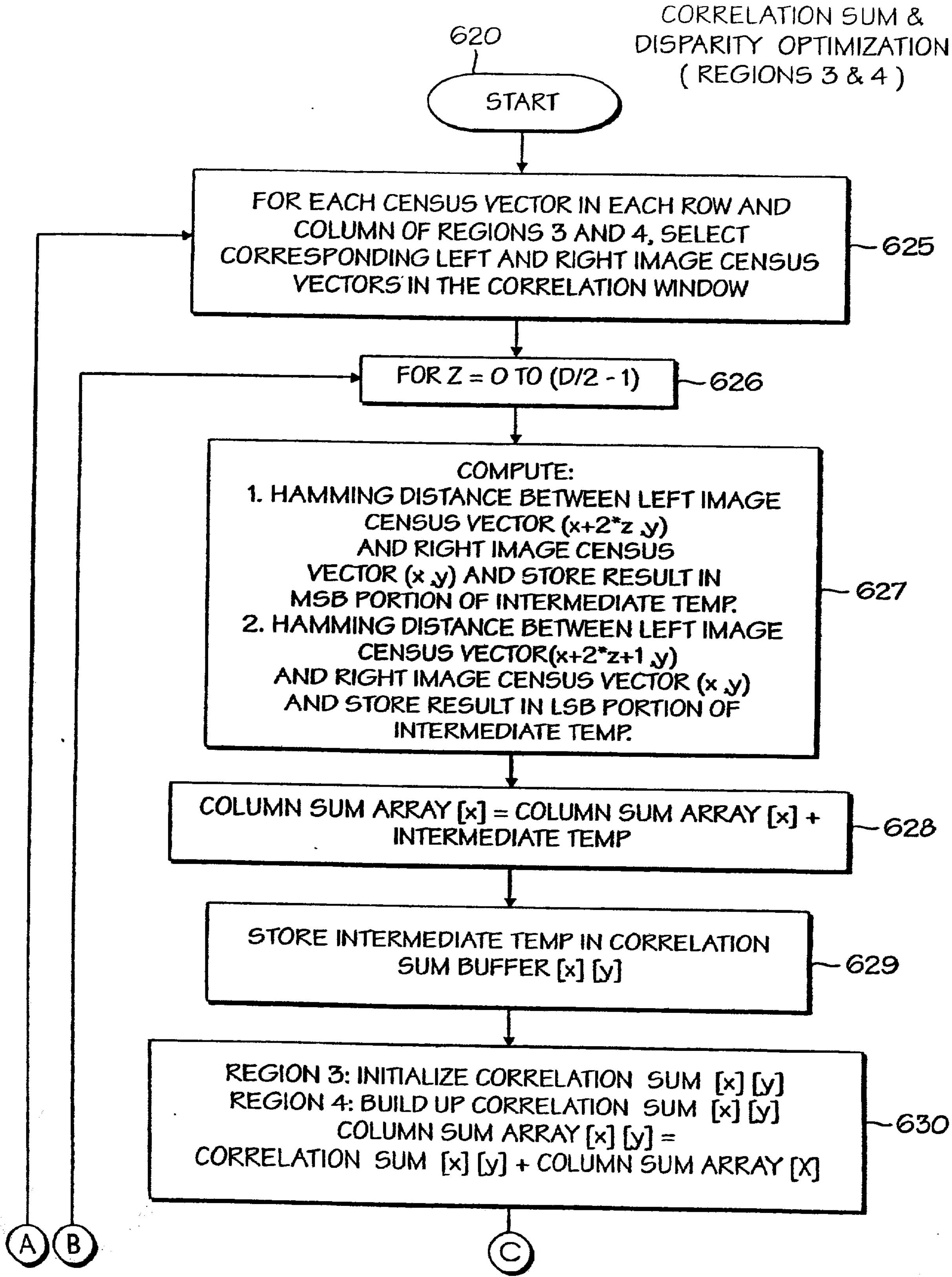

CORRELATION SUM & DISPARITY OPTIMIZATION (REGIONS 3 & 4)
620
START
FOR EACH CENSUS VECTOR IN EACH ROW AND COLUMN OF REGIONS 3 AND 4, SELECT CORRESPONDING LEFT AND RIGHT IMAGE CENSUS VECTORS IN THE CORRELATION WINDOW
625
FOR Z = 0 TO (D/2 - 1)
626
COMPUTE:
1. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN MSB PORTION OF INTERMEDIATE TEMP.
2. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR(x+2*z+1 ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN LSB PORTION OF INTERMEDIATE TEMP.
627
COLUMN SUM ARRAY [x] = COLUMN SUM ARRAY [x] + INTERMEDIATE TEMP
628
STORE INTERMEDIATE TEMP IN CORRELATION SUM BUFFER [x] [y]
629
REGION 3: INITIALIZE CORRELATION SUM [x] [y]
REGION 4: BUILD UP CORRELATION SUM [x] [y]
COLUMN SUM ARRAY [x] [y] =
CORRELATION SUM [x] [y] + COLUMN SUM ARRAY [X]
630
A
B
C

FIG. 22(A)

CORRELATION SUM &
DISPARITY OPTIMIZATION
(REGIONS 3 & 4)

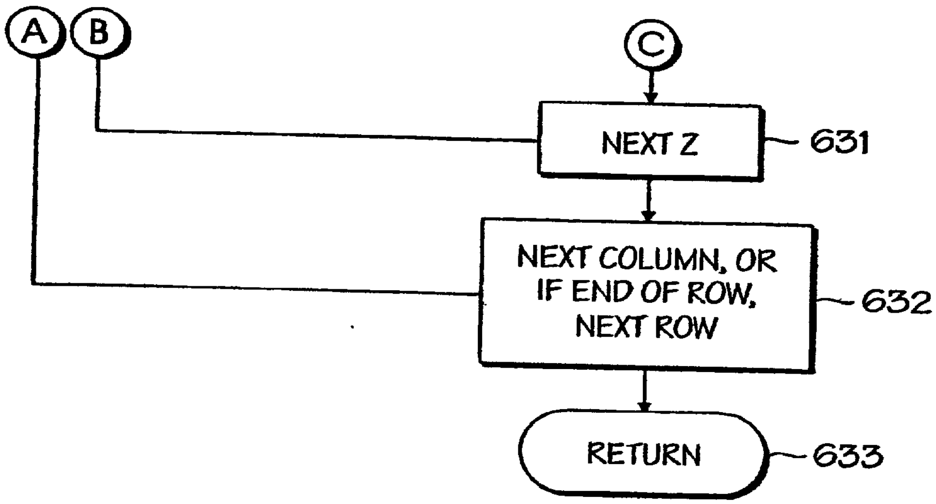


FIG. 22(B)

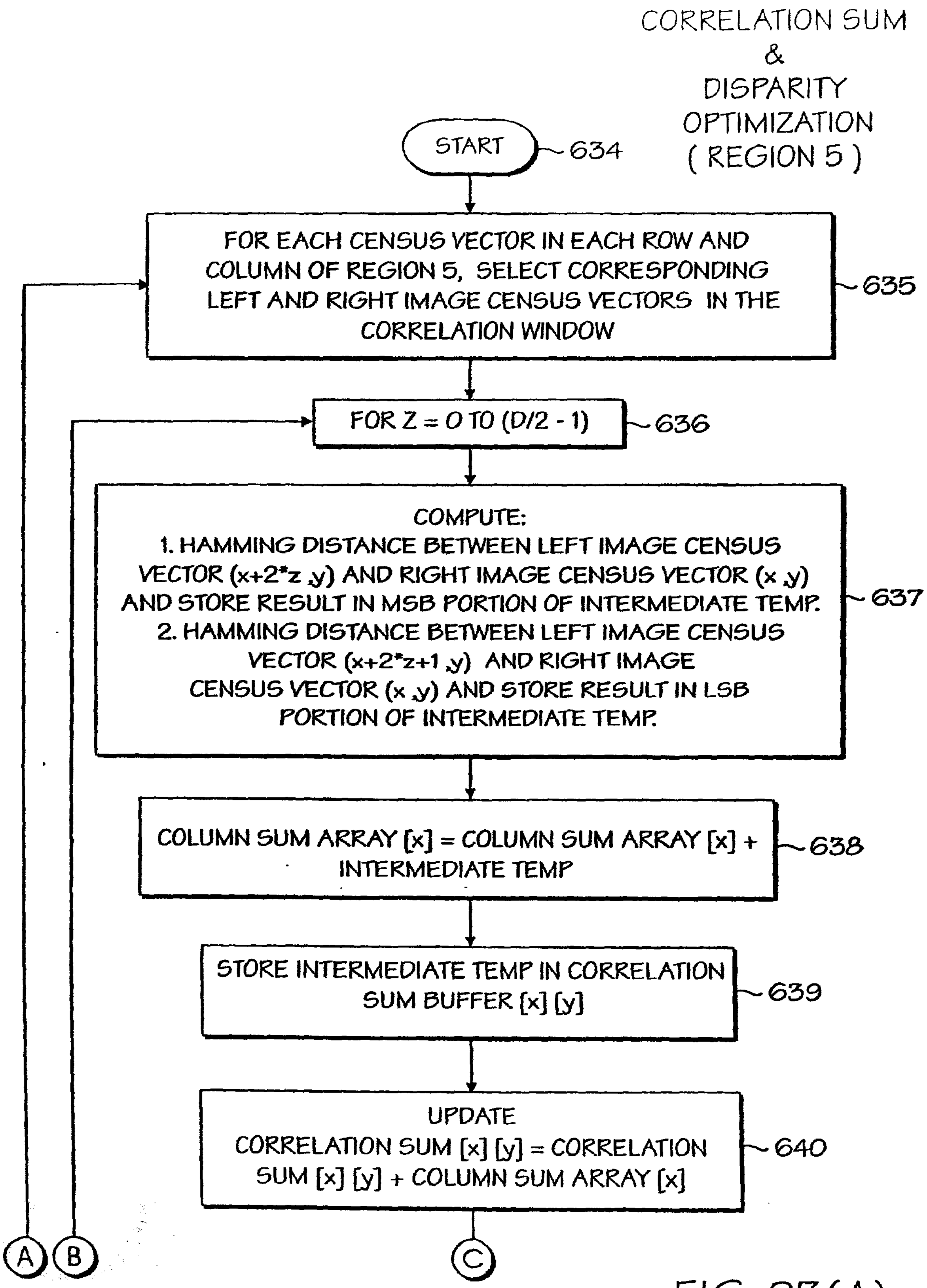

CORRELATION SUM & DISPARITY OPTIMIZATION (REGION 5)
START
634
FOR EACH CENSUS VECTOR IN EACH ROW AND COLUMN OF REGION 5, SELECT CORRESPONDING LEFT AND RIGHT IMAGE CENSUS VECTORS IN THE CORRELATION WINDOW
635
FOR Z = 0 TO (D/2 - 1)
636
COMPUTE:
1. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN MSB PORTION OF INTERMEDIATE TEMP.
2. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z+1 ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN LSB PORTION OF INTERMEDIATE TEMP.
637
COLUMN SUM ARRAY [x] = COLUMN SUM ARRAY [x] + INTERMEDIATE TEMP
638
STORE INTERMEDIATE TEMP IN CORRELATION SUM BUFFER [x] [y]
639
UPDATE
CORRELATION SUM [x] [y] = CORRELATION SUM [x] [y] + COLUMN SUM ARRAY [x]
640
A
B
C

FIG. 23(A)

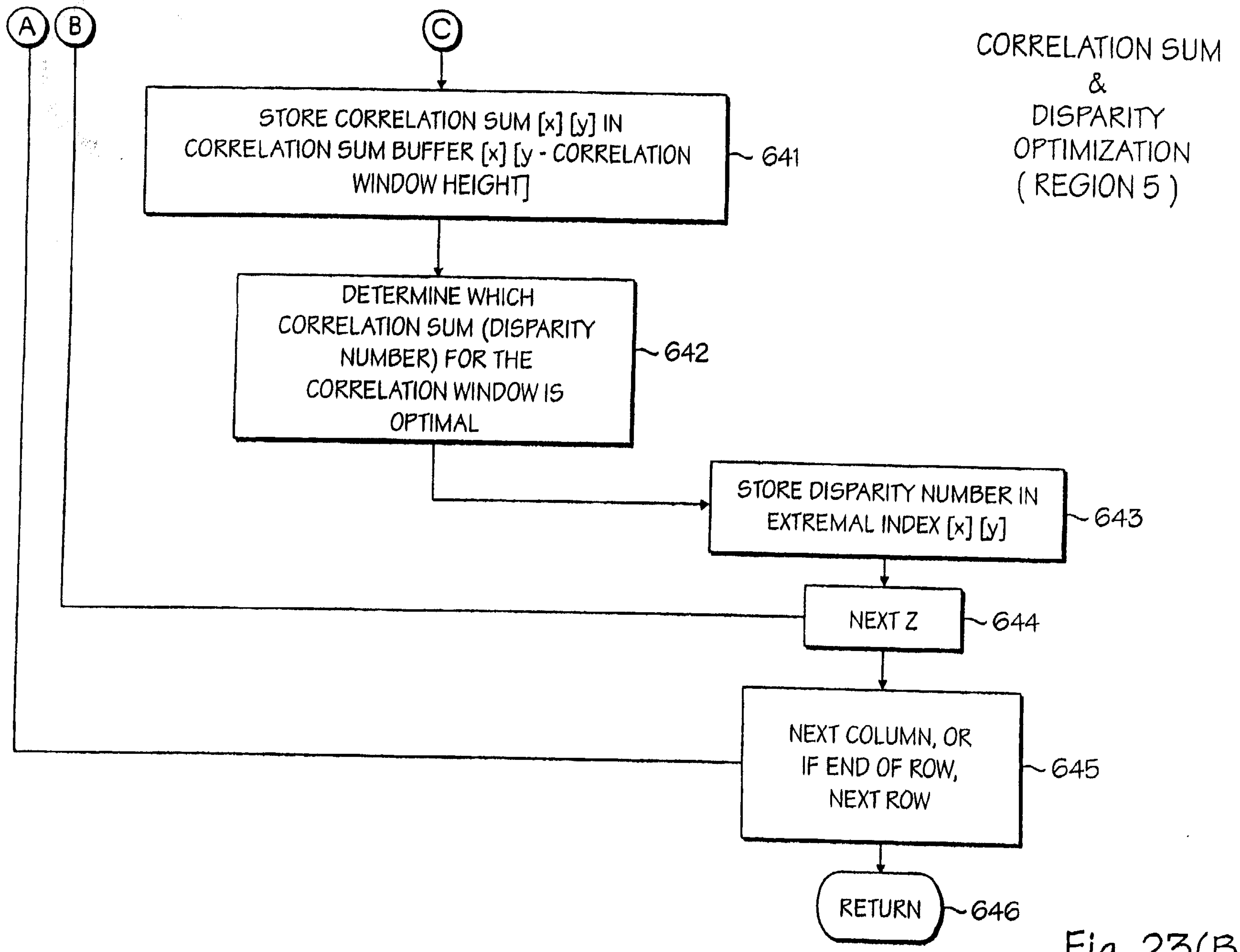

A
B
C
STORE CORRELATION SUM [x] [y] IN CORRELATION SUM BUFFER [x] [y - CORRELATION WINDOW HEIGHT]
641
CORRELATION SUM & DISPARITY OPTIMIZATION (REGION 5)
DETERMINE WHICH CORRELATION SUM (DISPARITY NUMBER) FOR THE CORRELATION WINDOW IS OPTIMAL
642
STORE DISPARITY NUMBER IN EXTREMAL INDEX [x] [y]
643
NEXT Z
644
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
645
RETURN
646

Fig. 23(B)

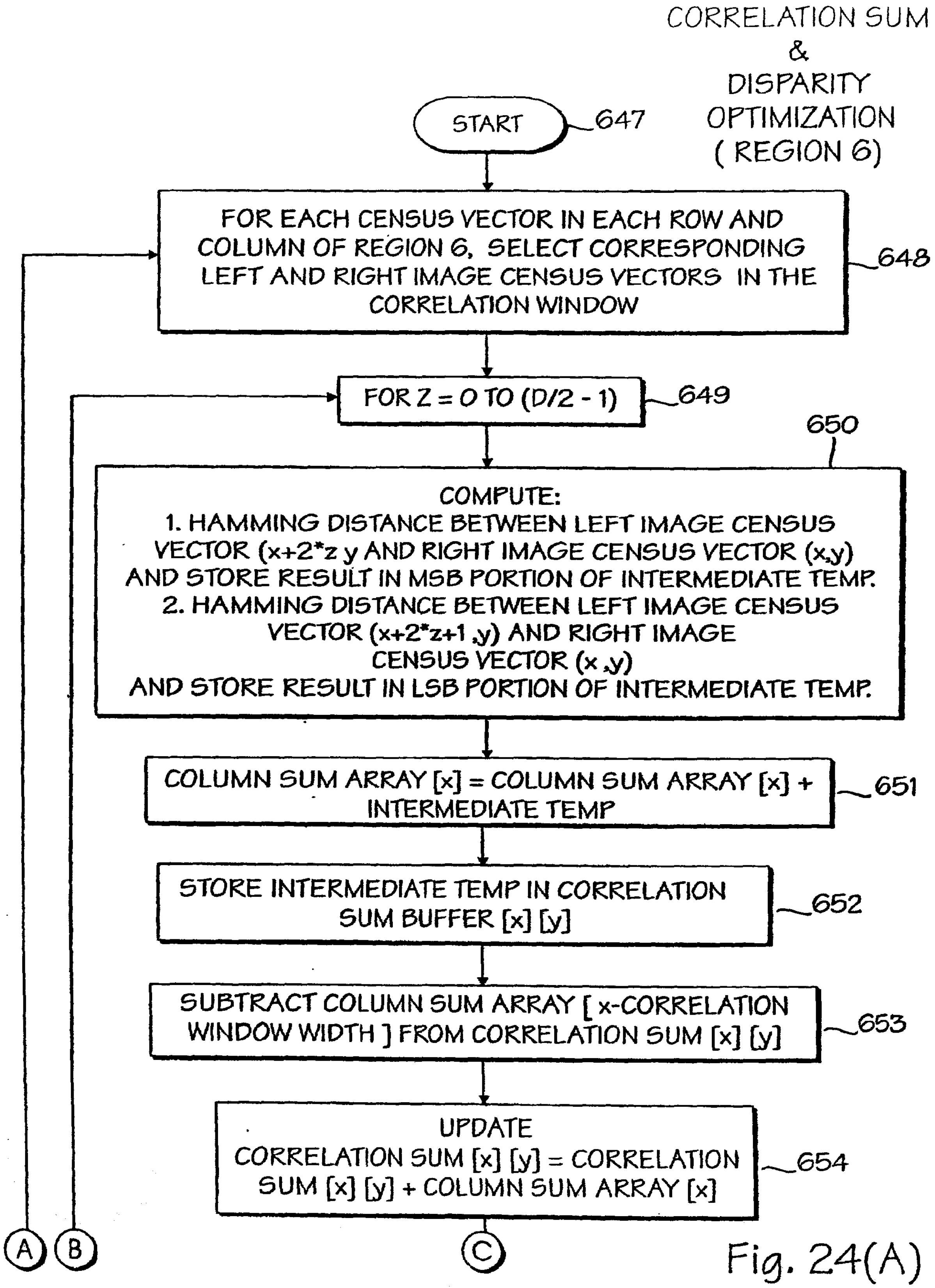

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGION 6)
START
647
FOR EACH CENSUS VECTOR IN EACH ROW AND COLUMN OF REGION 6, SELECT CORRESPONDING LEFT AND RIGHT IMAGE CENSUS VECTORS IN THE CORRELATION WINDOW
648
FOR Z = 0 TO (D/2 - 1)
649
650
COMPUTE:
1. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z y AND RIGHT IMAGE CENSUS VECTOR (x,y) AND STORE RESULT IN MSB PORTION OF INTERMEDIATE TEMP.
2. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z+1 ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y)
AND STORE RESULT IN LSB PORTION OF INTERMEDIATE TEMP.
COLUMN SUM ARRAY [x] = COLUMN SUM ARRAY [x] + INTERMEDIATE TEMP
651
STORE INTERMEDIATE TEMP IN CORRELATION SUM BUFFER [x] [y]
652
SUBTRACT COLUMN SUM ARRAY [x-CORRELATION WINDOW WIDTH] FROM CORRELATION SUM [x] [y]
653
UPDATE
CORRELATION SUM [x] [y] = CORRELATION SUM [x] [y] + COLUMN SUM ARRAY [x]
654
A
B
C

Fig. 24(A)

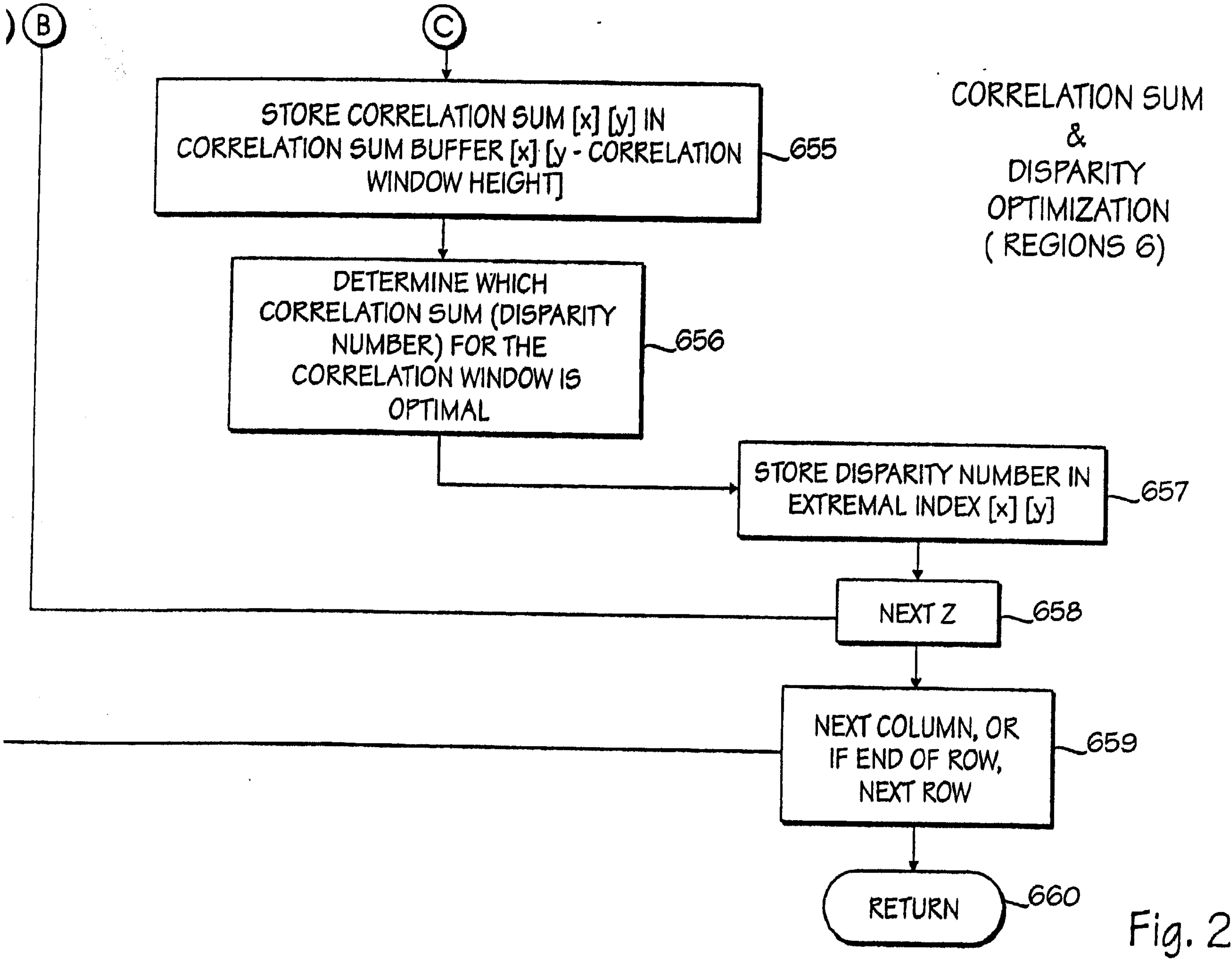

B
C
STORE CORRELATION SUM [x] [y] IN CORRELATION SUM BUFFER [x] [y - CORRELATION WINDOW HEIGHT]
655
CORRELATION SUM & DISPARITY OPTIMIZATION (REGIONS 6)
DETERMINE WHICH CORRELATION SUM (DISPARITY NUMBER) FOR THE CORRELATION WINDOW IS OPTIMAL
656
STORE DISPARITY NUMBER IN EXTREMAL INDEX [x] [y]
657
NEXT Z
658
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
659
RETURN
660

Fig. 24(B)

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGIONS 7 & 8)

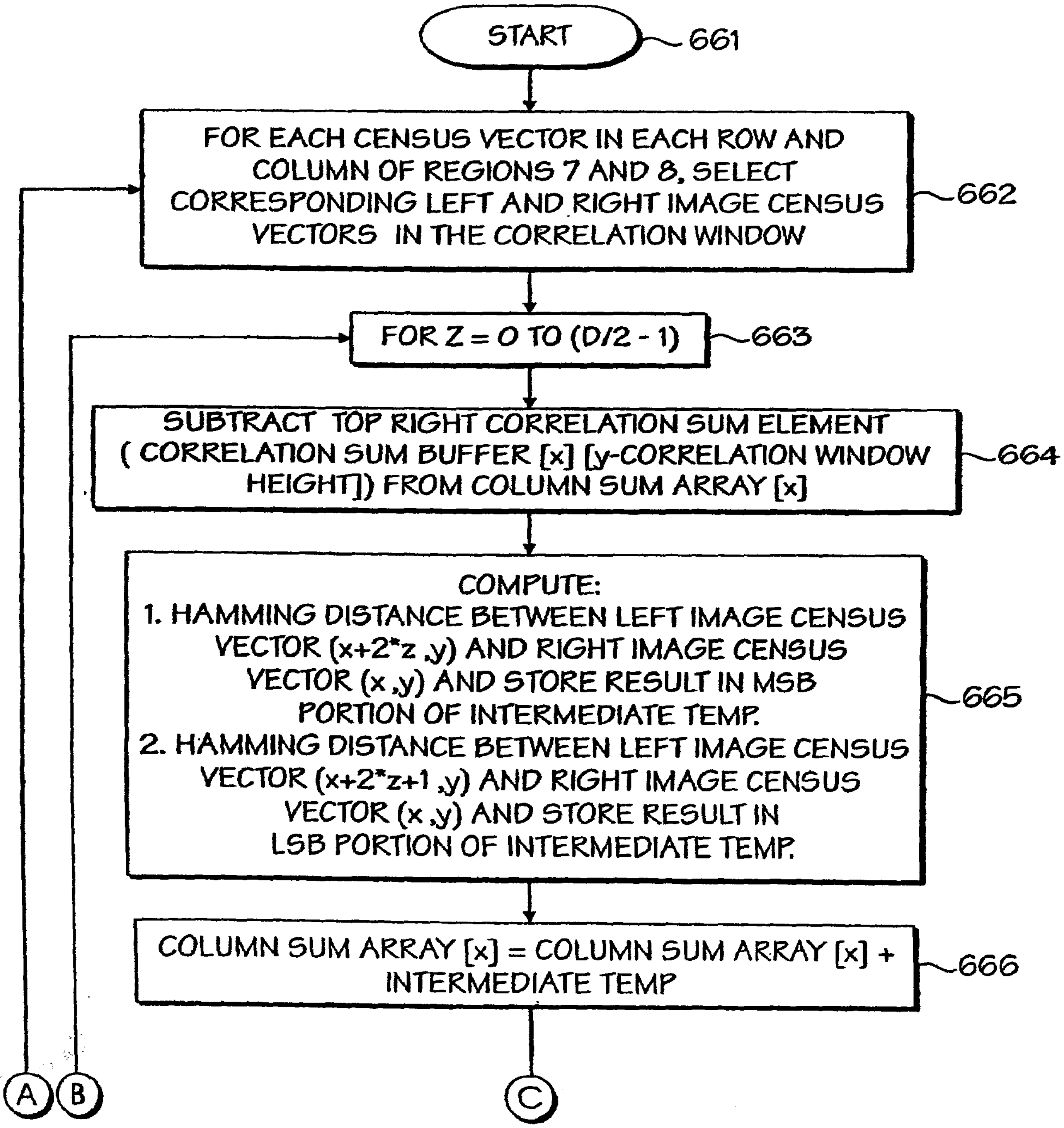


Fig. 25(A)

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGIONS 7 & 8)

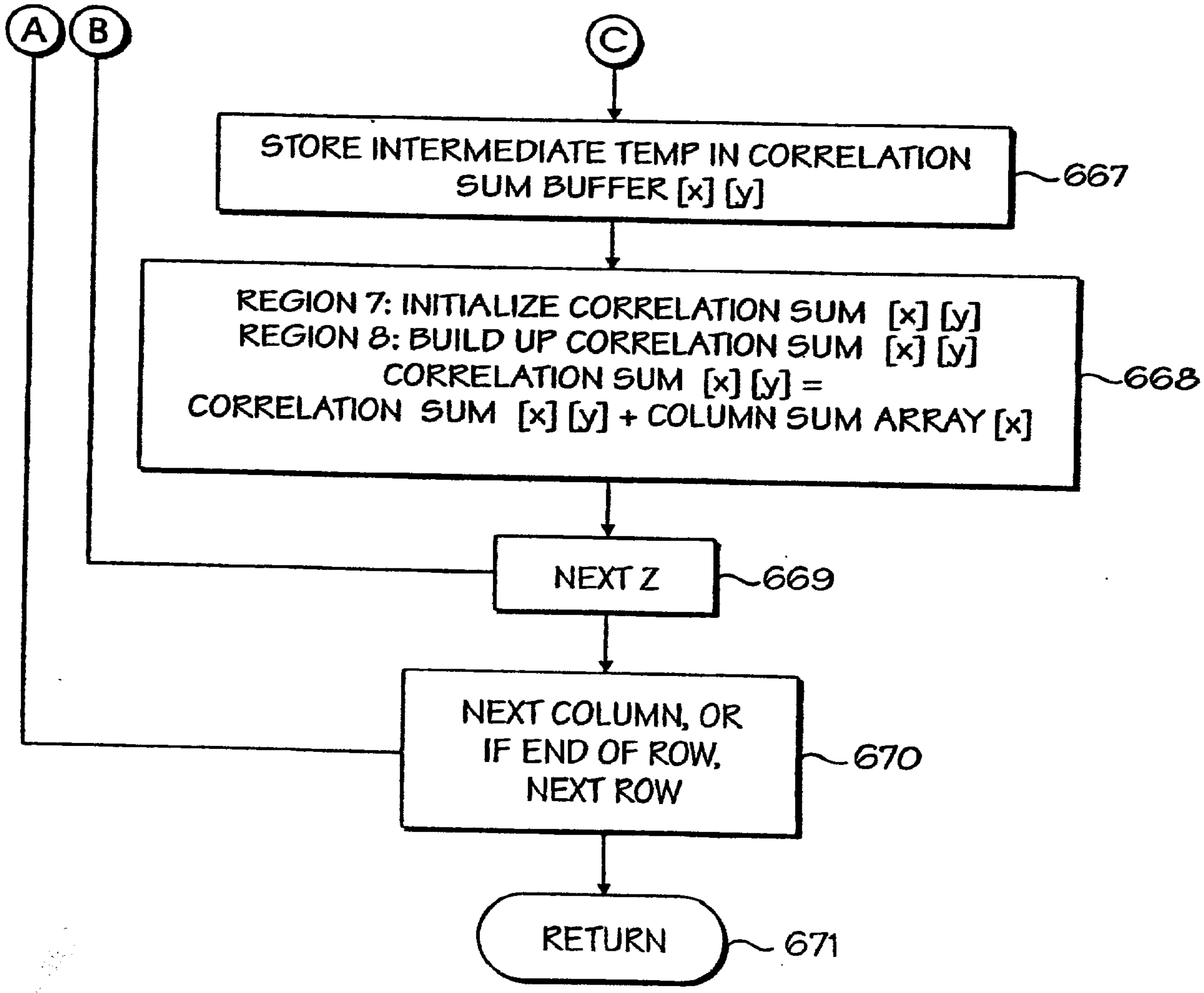


Fig. 25(B)

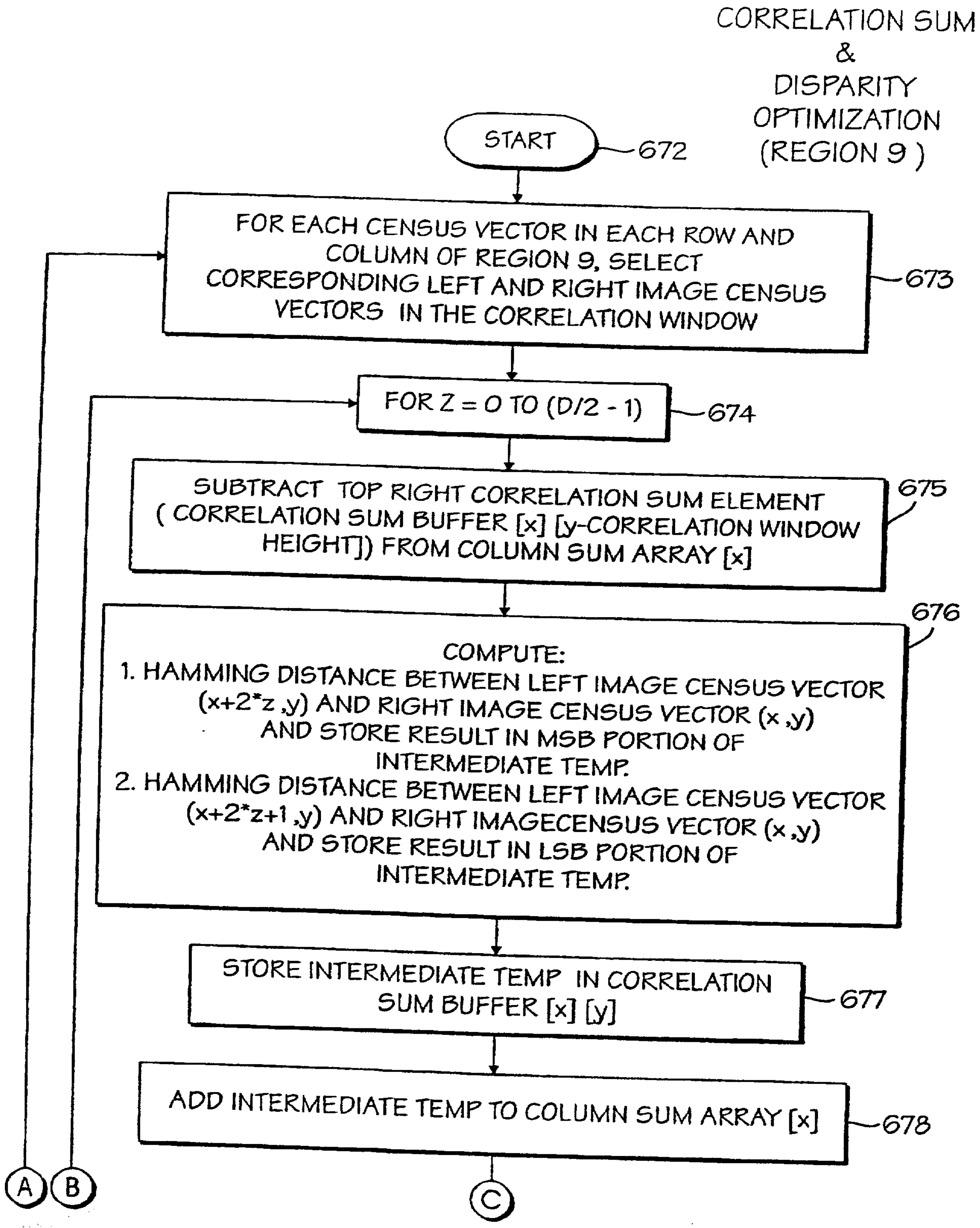

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGION 9)
START
672
FOR EACH CENSUS VECTOR IN EACH ROW AND COLUMN OF REGION 9, SELECT CORRESPONDING LEFT AND RIGHT IMAGE CENSUS VECTORS IN THE CORRELATION WINDOW
673
FOR Z = 0 TO (D/2 - 1)
674
SUBTRACT TOP RIGHT CORRELATION SUM ELEMENT (CORRELATION SUM BUFFER [x] [y-CORRELATION WINDOW HEIGHT]) FROM COLUMN SUM ARRAY [x]
675
COMPUTE:
1. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z ,y) AND RIGHT IMAGE CENSUS VECTOR (x ,y) AND STORE RESULT IN MSB PORTION OF INTERMEDIATE TEMP.
2. HAMMING DISTANCE BETWEEN LEFT IMAGE CENSUS VECTOR (x+2*z+1 ,y) AND RIGHT IMAGECENSUS VECTOR (x ,y) AND STORE RESULT IN LSB PORTION OF INTERMEDIATE TEMP.
676
STORE INTERMEDIATE TEMP IN CORRELATION SUM BUFFER [x] [y]
677
ADD INTERMEDIATE TEMP TO COLUMN SUM ARRAY [x]
678
A
B
C

FIG. 26(A)

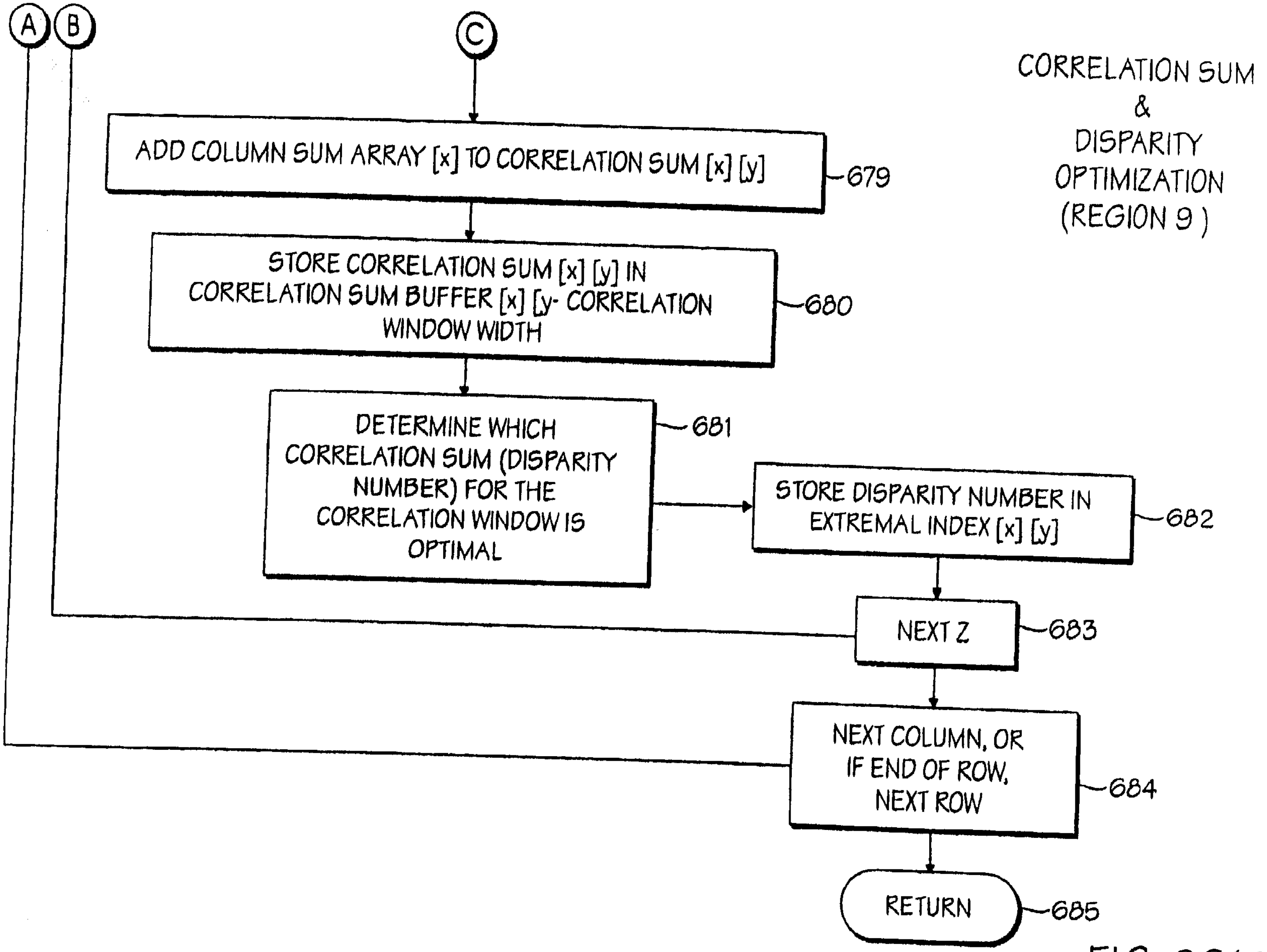

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGION 9)
A
B
C
ADD COLUMN SUM ARRAY [x] TO CORRELATION SUM [x] [y]
679
STORE CORRELATION SUM [x] [y] IN CORRELATION SUM BUFFER [x] [y- CORRELATION WINDOW WIDTH
680
DETERMINE WHICH CORRELATION SUM (DISPARITY NUMBER) FOR THE CORRELATION WINDOW IS OPTIMAL
681
STORE DISPARITY NUMBER IN EXTREMAL INDEX [x] [y]
682
NEXT Z
683
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
684
RETURN
685

FIG. 26(B)

CORRELATION SUM
&
DISPARITY OPTIMIZATION
(REGION 10)

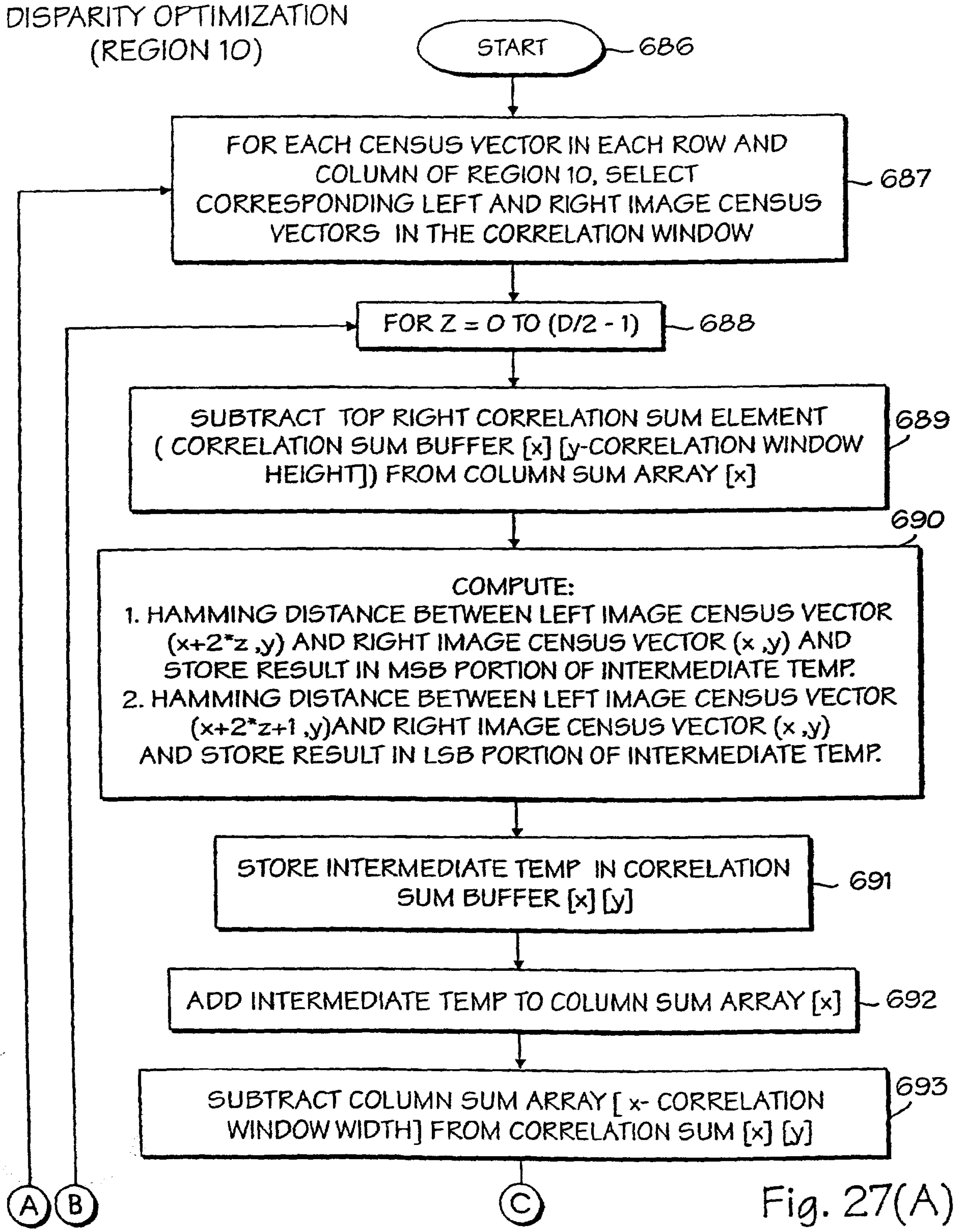


Fig. 27(A)

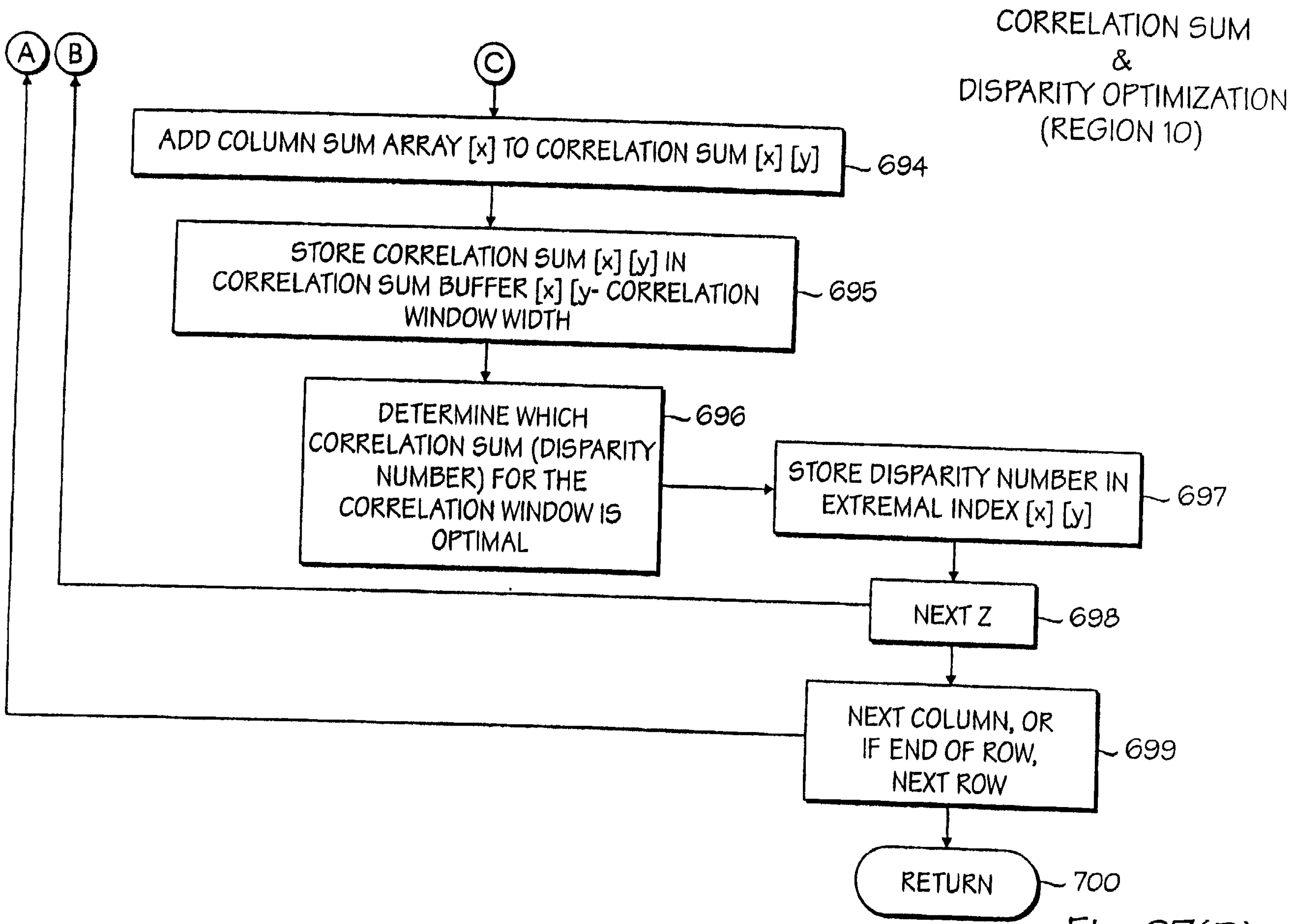
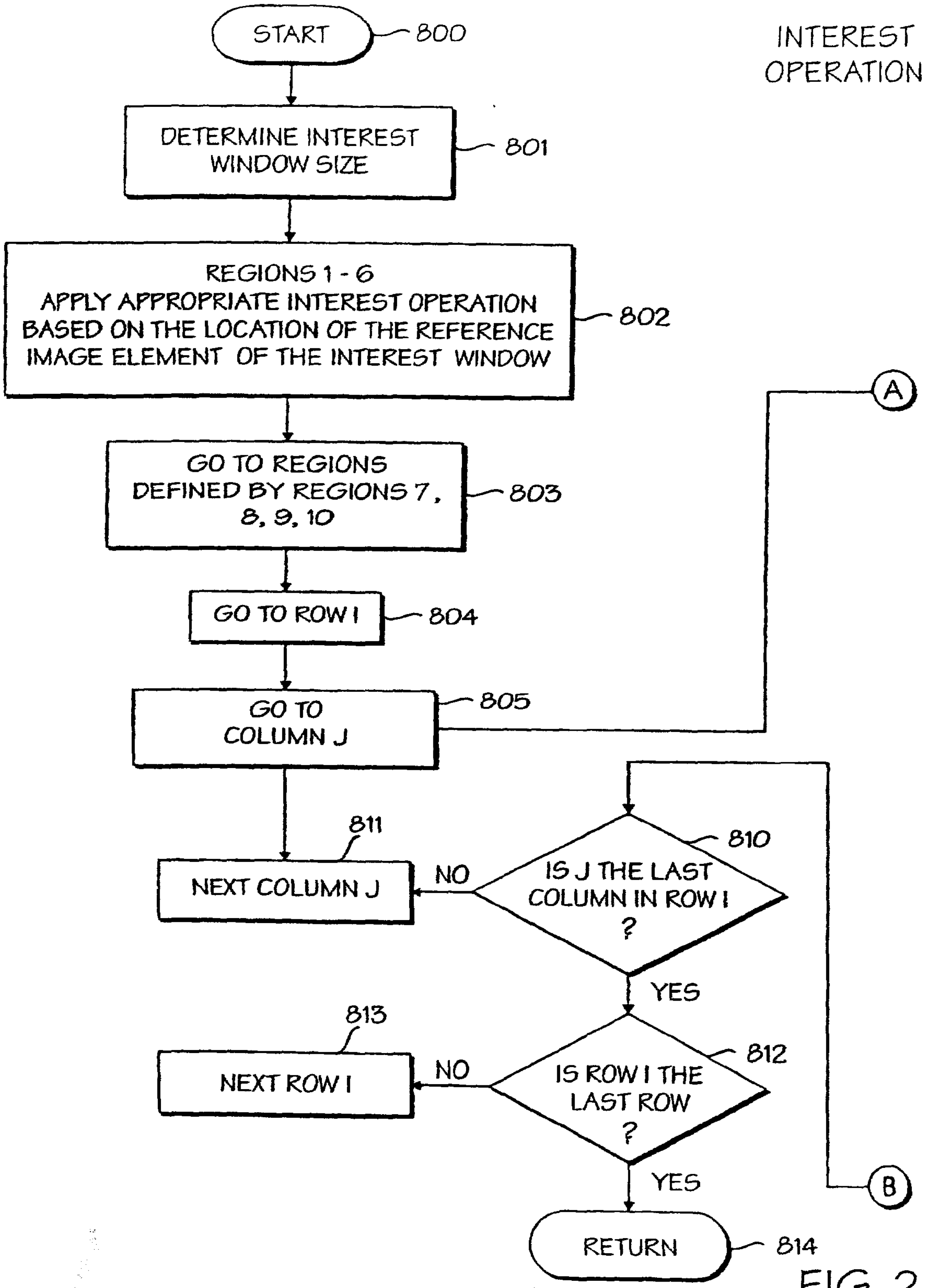

CORRELATION SUM
&
DISPARITY OPTIMIZATION
(REGION 10)
A
B
C
ADD COLUMN SUM ARRAY [x] TO CORRELATION SUM [x] [y]
694
STORE CORRELATION SUM [x] [y] IN CORRELATION SUM BUFFER [x] [y- CORRELATION WINDOW WIDTH
695
DETERMINE WHICH CORRELATION SUM (DISPARITY NUMBER) FOR THE CORRELATION WINDOW IS OPTIMAL
696
STORE DISPARITY NUMBER IN EXTREMAL INDEX [x] [y]
697
NEXT Z
698
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
699
RETURN
700

Fig. 27(B)



START
800
INTEREST OPERATION
DETERMINE INTEREST WINDOW SIZE
801
REGIONS 1 - 6
APPLY APPROPRIATE INTEREST OPERATION BASED ON THE LOCATION OF THE REFERENCE IMAGE ELEMENT OF THE INTEREST WINDOW
802
A
GO TO REGIONS DEFINED BY REGIONS 7, 8, 9, 10
803
GO TO ROW I
804
GO TO COLUMN J
805
811
NEXT COLUMN J
NO
IS J THE LAST COLUMN IN ROW I ?
810
YES
813
NEXT ROW I
NO
IS ROW I THE LAST ROW ?
812
YES
B
RETURN
814

FIG. 28(A)

INTEREST OPERATION

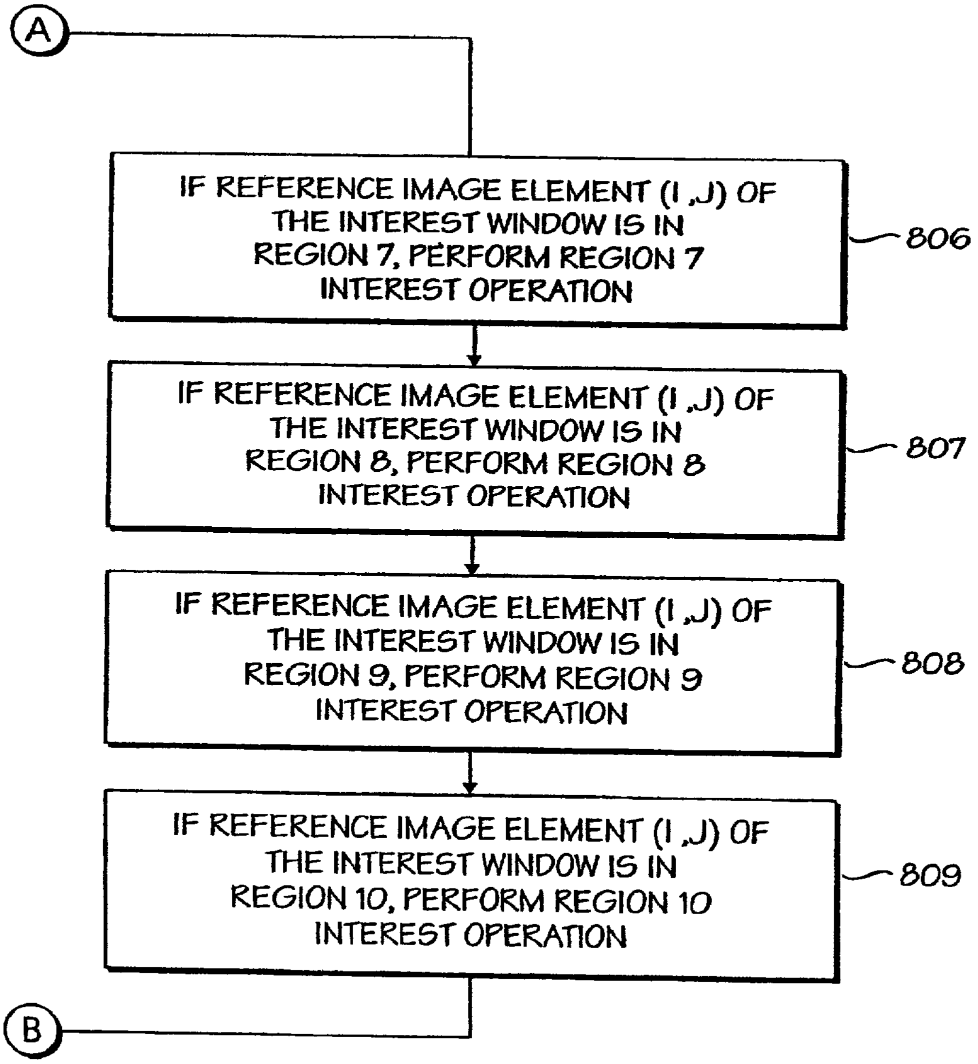


FIG. 28(B)

INTEREST
OPERATION
(REGIONS 1 & 2)

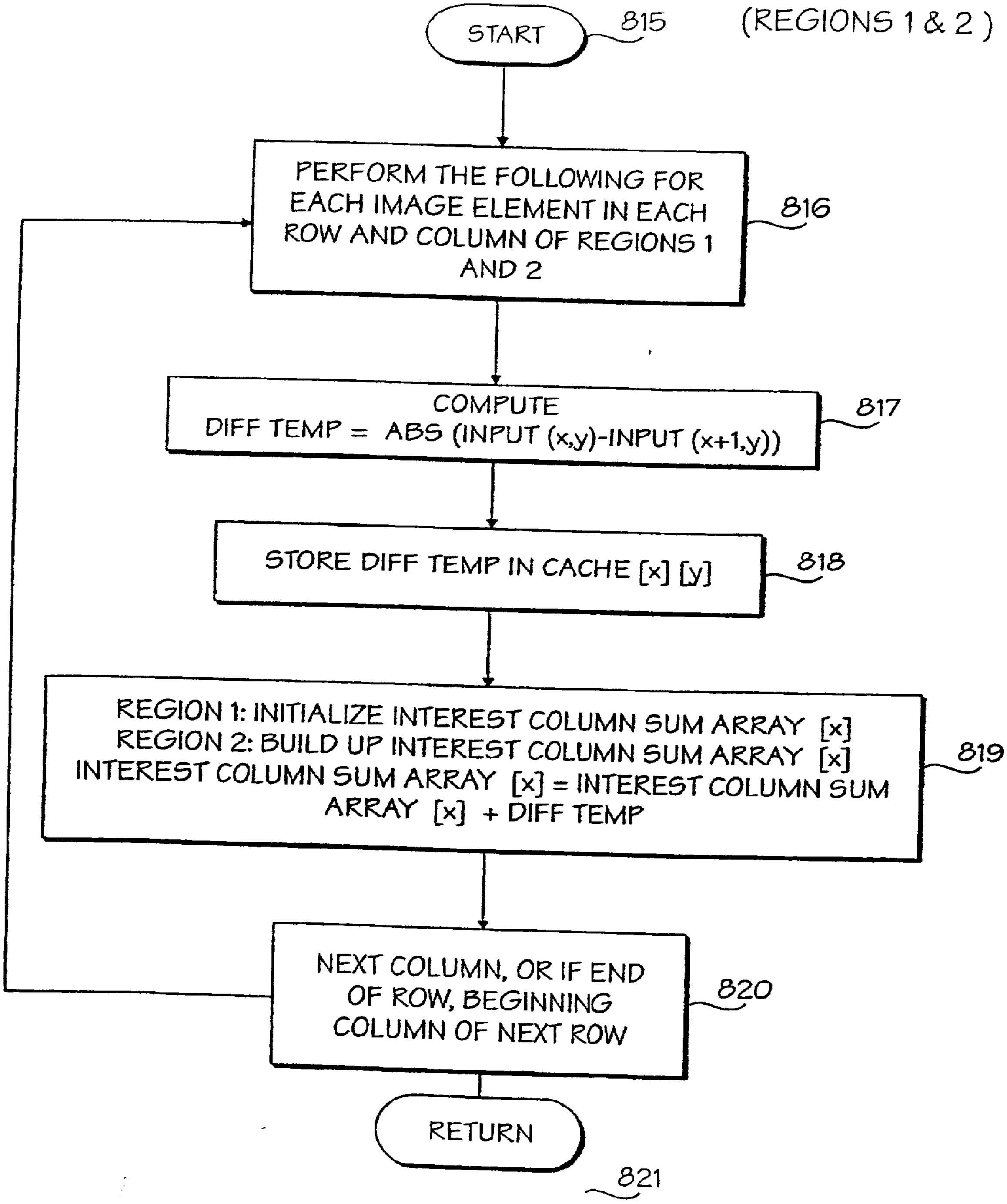
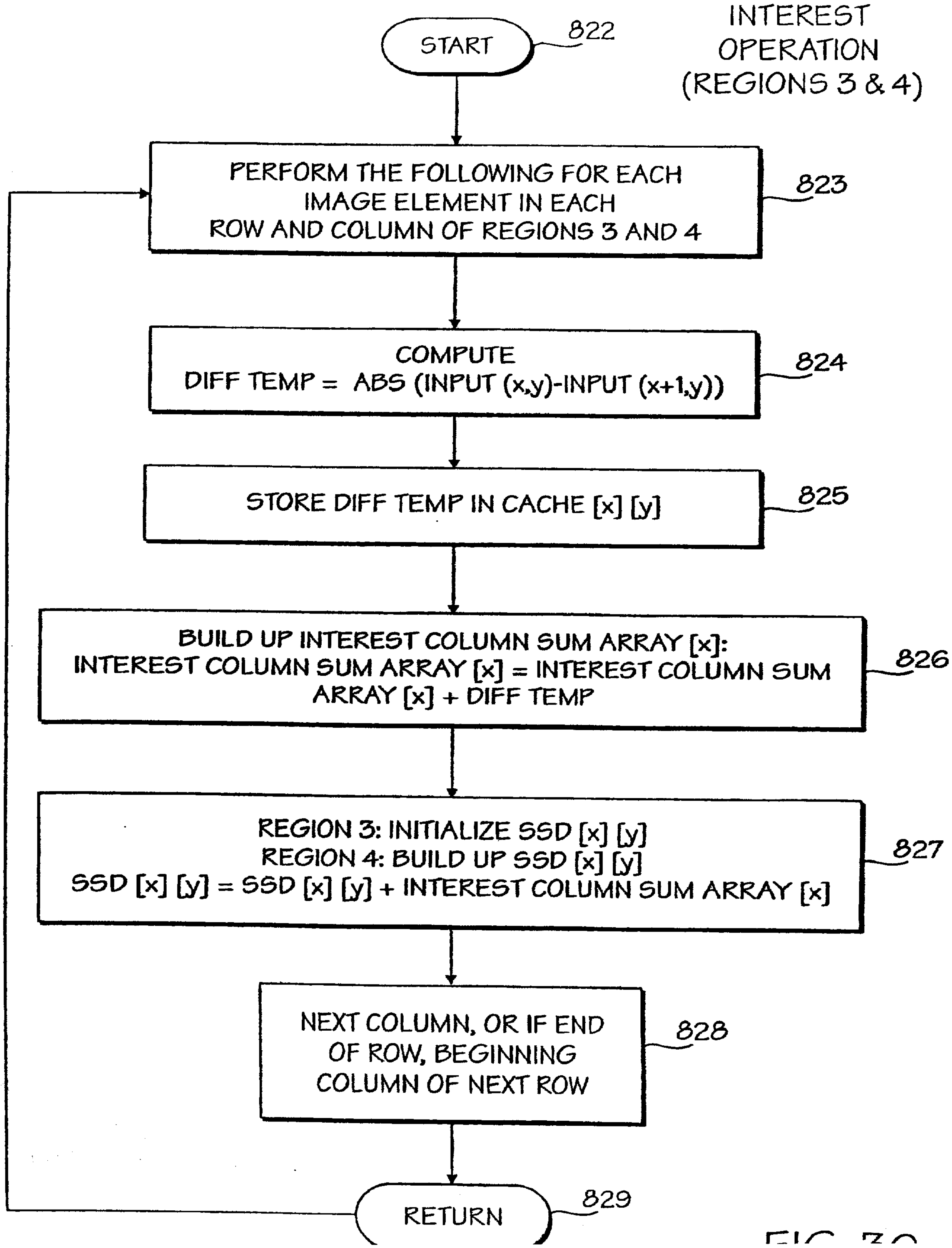


FIG. 29


INTEREST OPERATION (REGIONS 3 & 4)
START
822
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT IN EACH ROW AND COLUMN OF REGIONS 3 AND 4
823
COMPUTE DIFF TEMP = ABS (INPUT (x,y)-INPUT (x+1,y))
824
STORE DIFF TEMP IN CACHE [x] [y]
825
BUILD UP INTEREST COLUMN SUM ARRAY [x]: INTEREST COLUMN SUM ARRAY [x] = INTEREST COLUMN SUM ARRAY [x] + DIFF TEMP
826
REGION 3: INITIALIZE SSD [x] [y]
REGION 4: BUILD UP SSD [x] [y]
SSD [x] [y] = SSD [x] [y] + INTEREST COLUMN SUM ARRAY [x]
827
NEXT COLUMN, OR IF END OF ROW, BEGINNING COLUMN OF NEXT ROW
828
RETURN
829

INTEREST OPERATION (REGION 5)

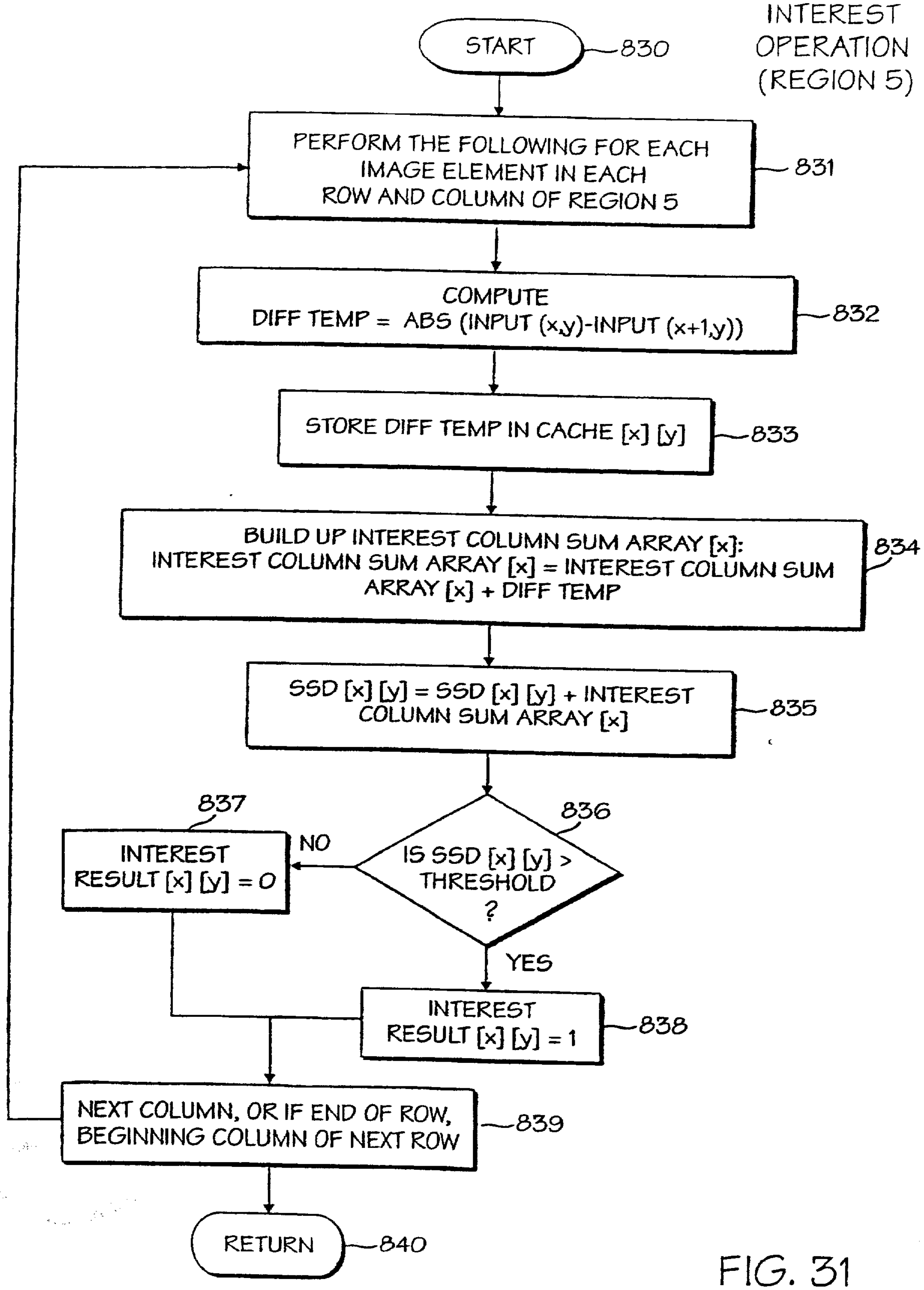


FIG. 31

INTEREST OPERATION (REGION 6)

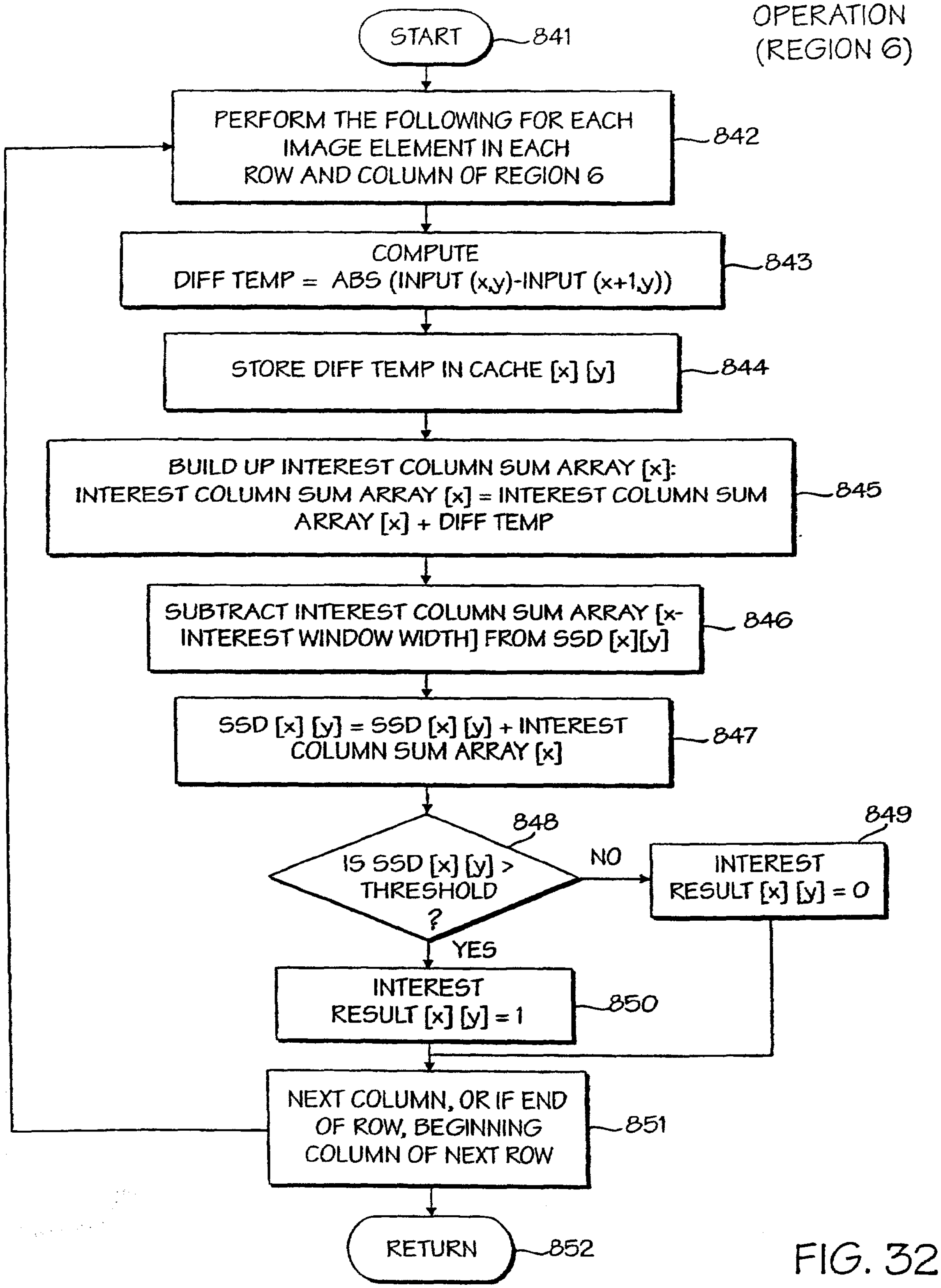


FIG. 32

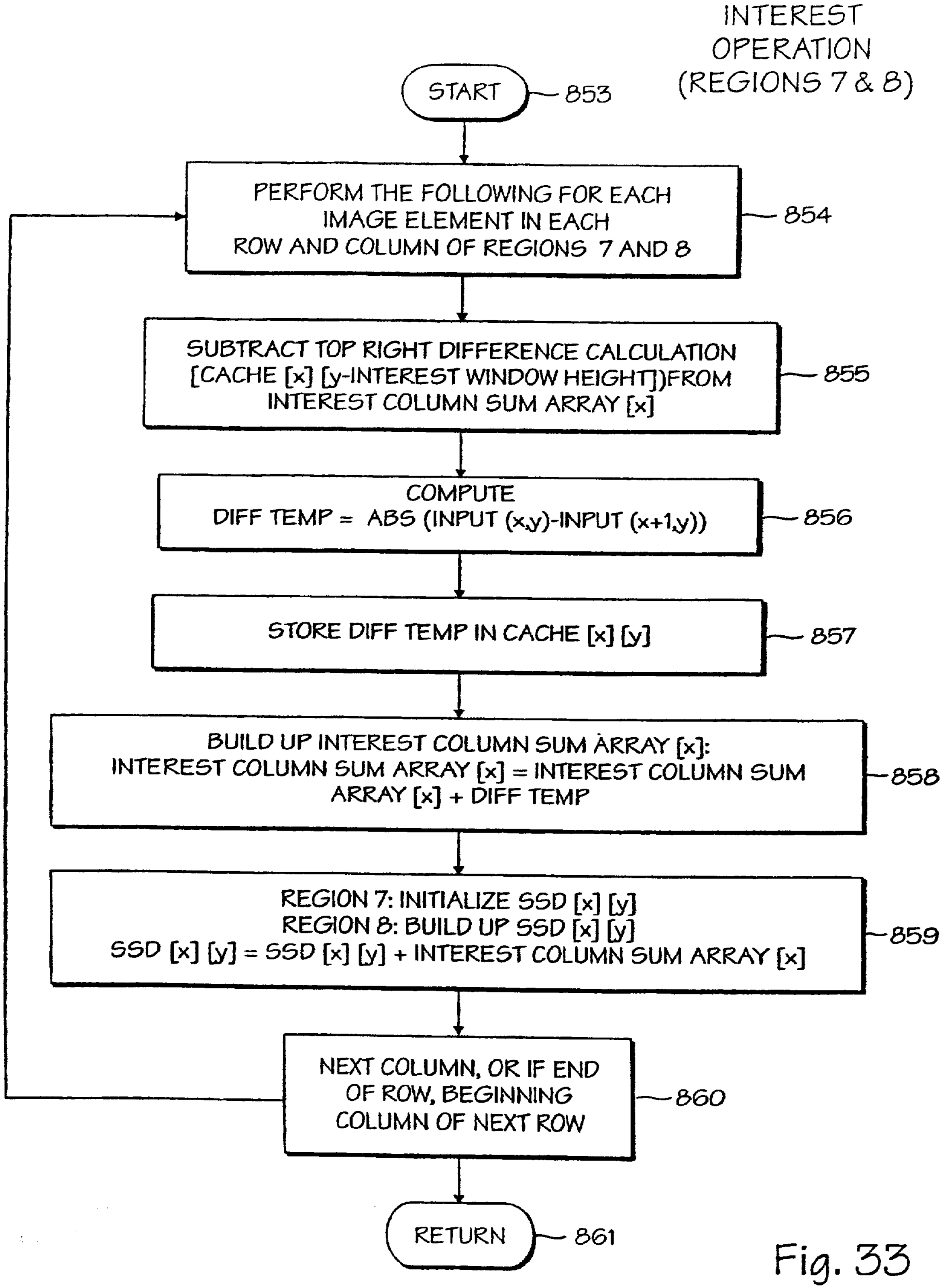

INTEREST OPERATION (REGIONS 7 & 8)
START
853
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT IN EACH ROW AND COLUMN OF REGIONS 7 AND 8
854
SUBTRACT TOP RIGHT DIFFERENCE CALCULATION [CACHE [x] [y-INTEREST WINDOW HEIGHT])FROM INTEREST COLUMN SUM ARRAY [x]
855
COMPUTE DIFF TEMP = ABS (INPUT (x,y)-INPUT (x+1,y))
856
STORE DIFF TEMP IN CACHE [x] [y]
857
BUILD UP INTEREST COLUMN SUM ARRAY [x]: INTEREST COLUMN SUM ARRAY [x] = INTEREST COLUMN SUM ARRAY [x] + DIFF TEMP
858
REGION 7: INITIALIZE SSD [x] [y]
REGION 8: BUILD UP SSD [x] [y]
SSD [x] [y] = SSD [x] [y] + INTEREST COLUMN SUM ARRAY [x]
859
NEXT COLUMN, OR IF END OF ROW, BEGINNING COLUMN OF NEXT ROW
860
RETURN
861

Fig. 33

INTEREST OPERATION (REGION 9)

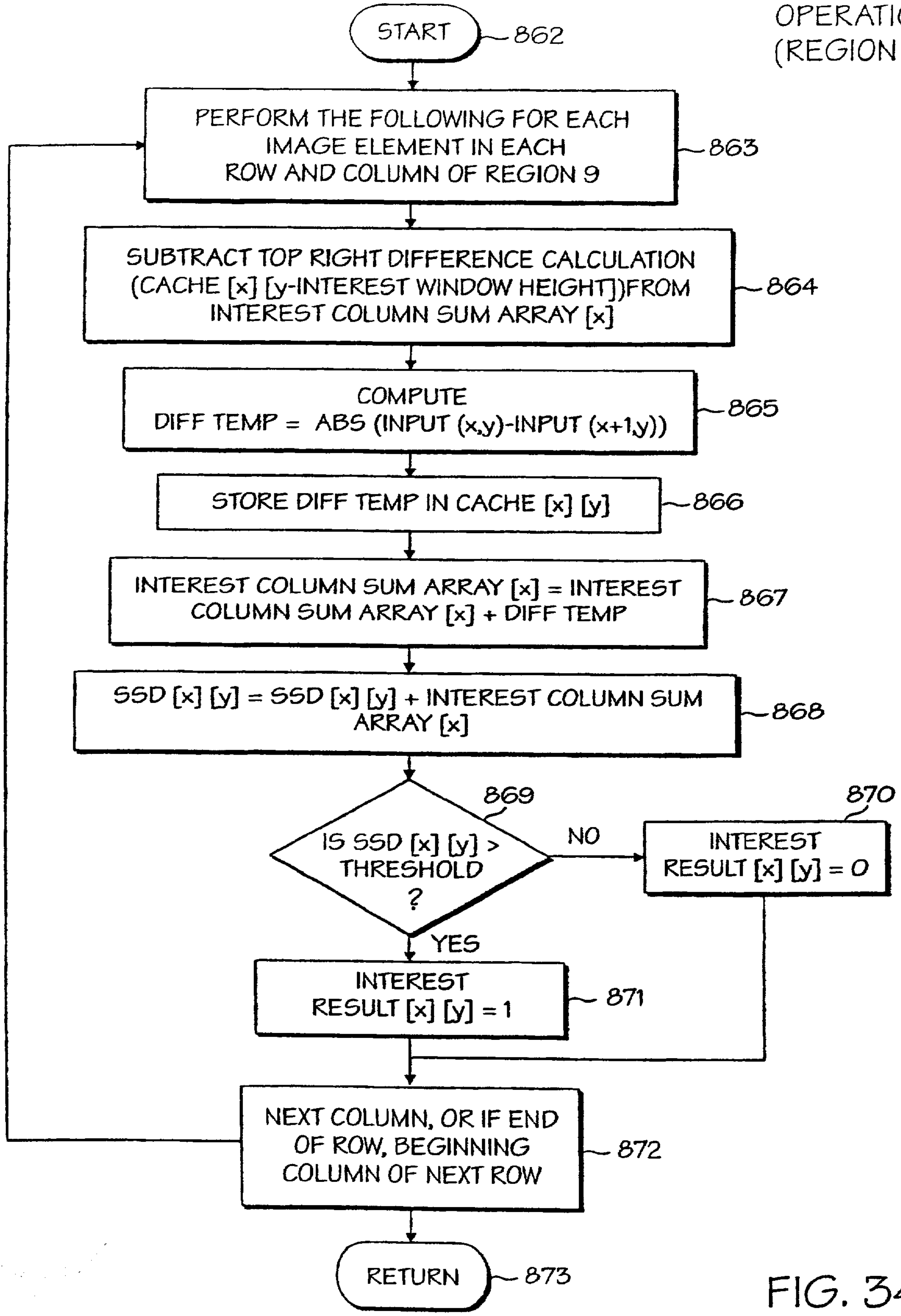


FIG. 34

INTEREST
OPERATION
(REGION 10)

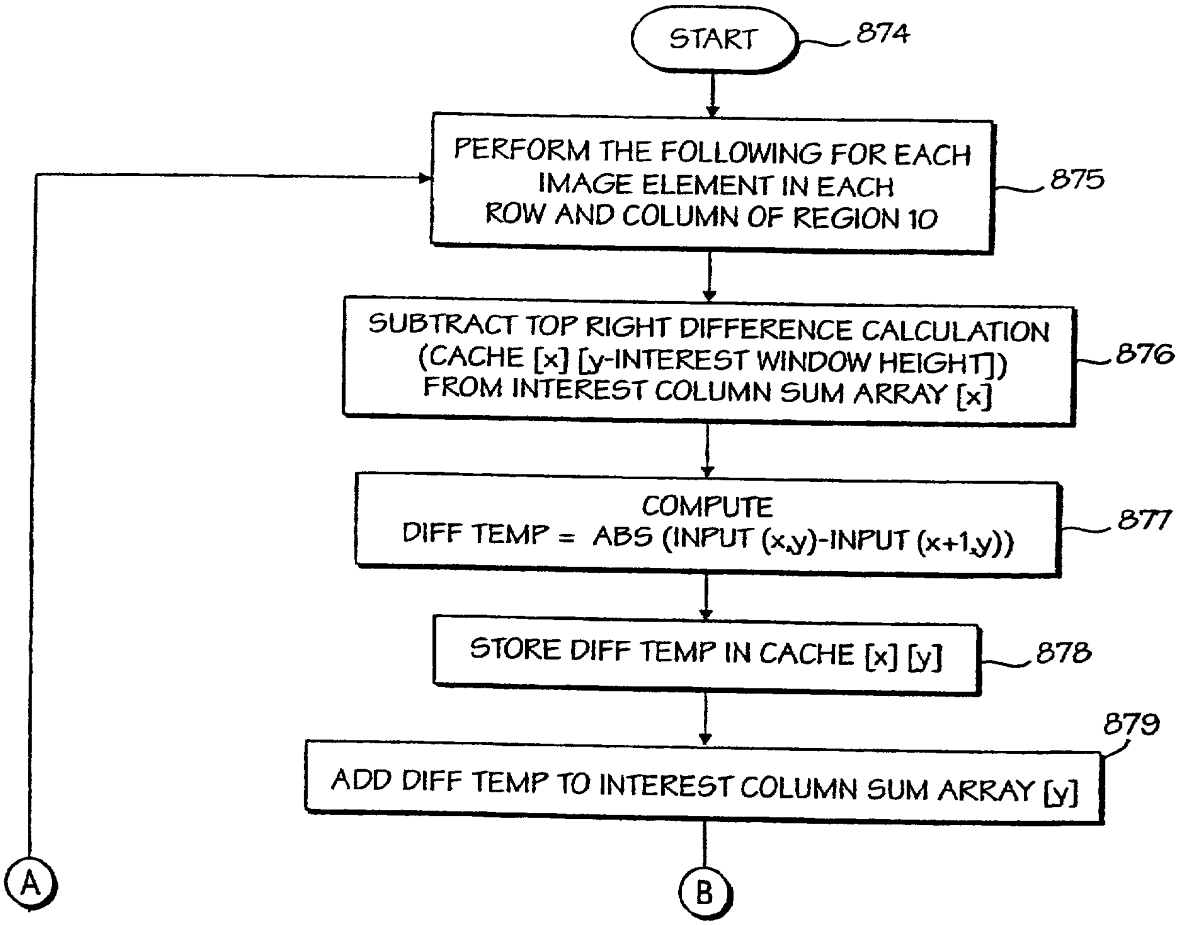


Fig. 35(A)

INTEREST
OPERATION
(REGION 10)

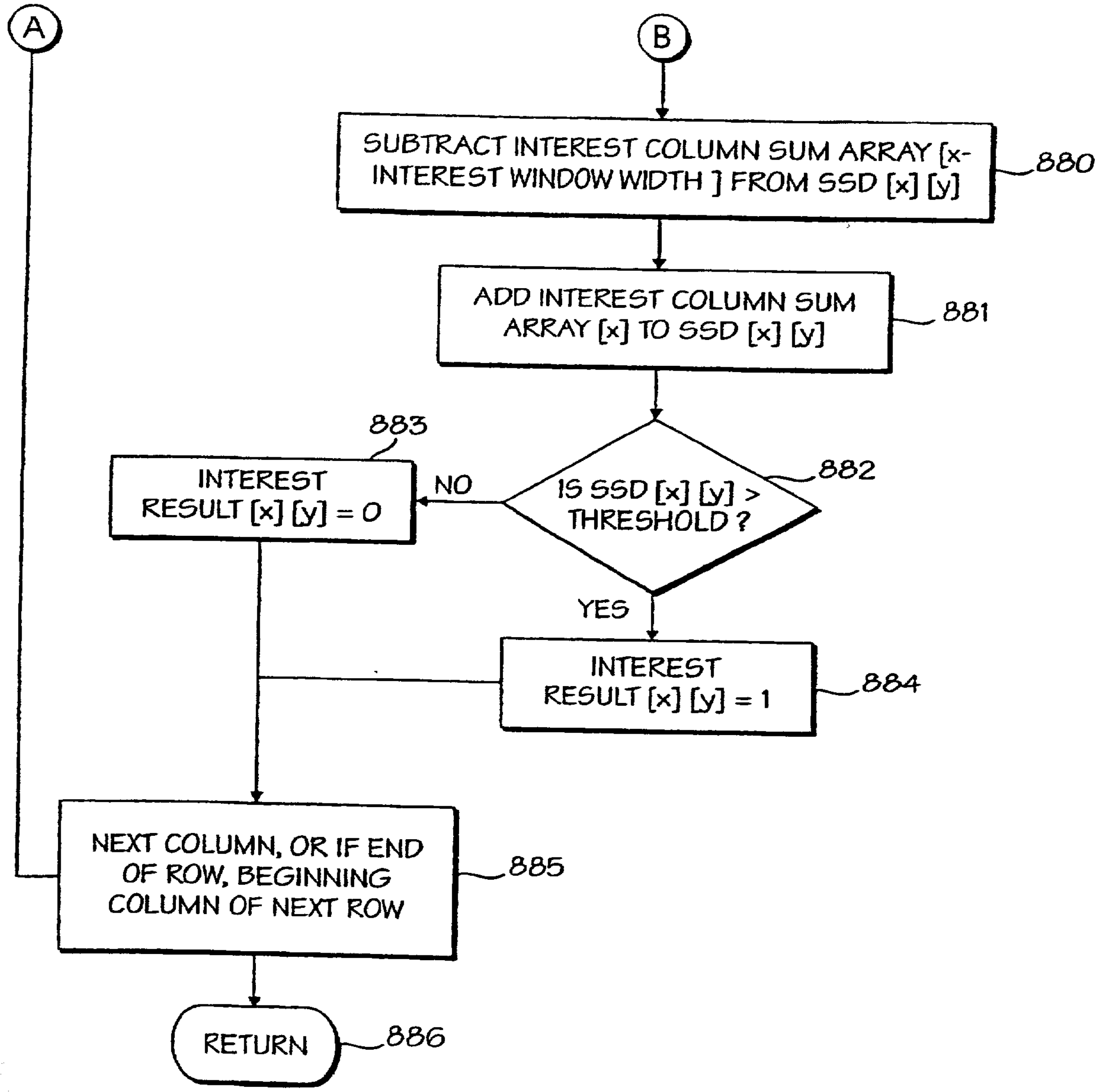


Fig. 35(B)

DATA PACKING

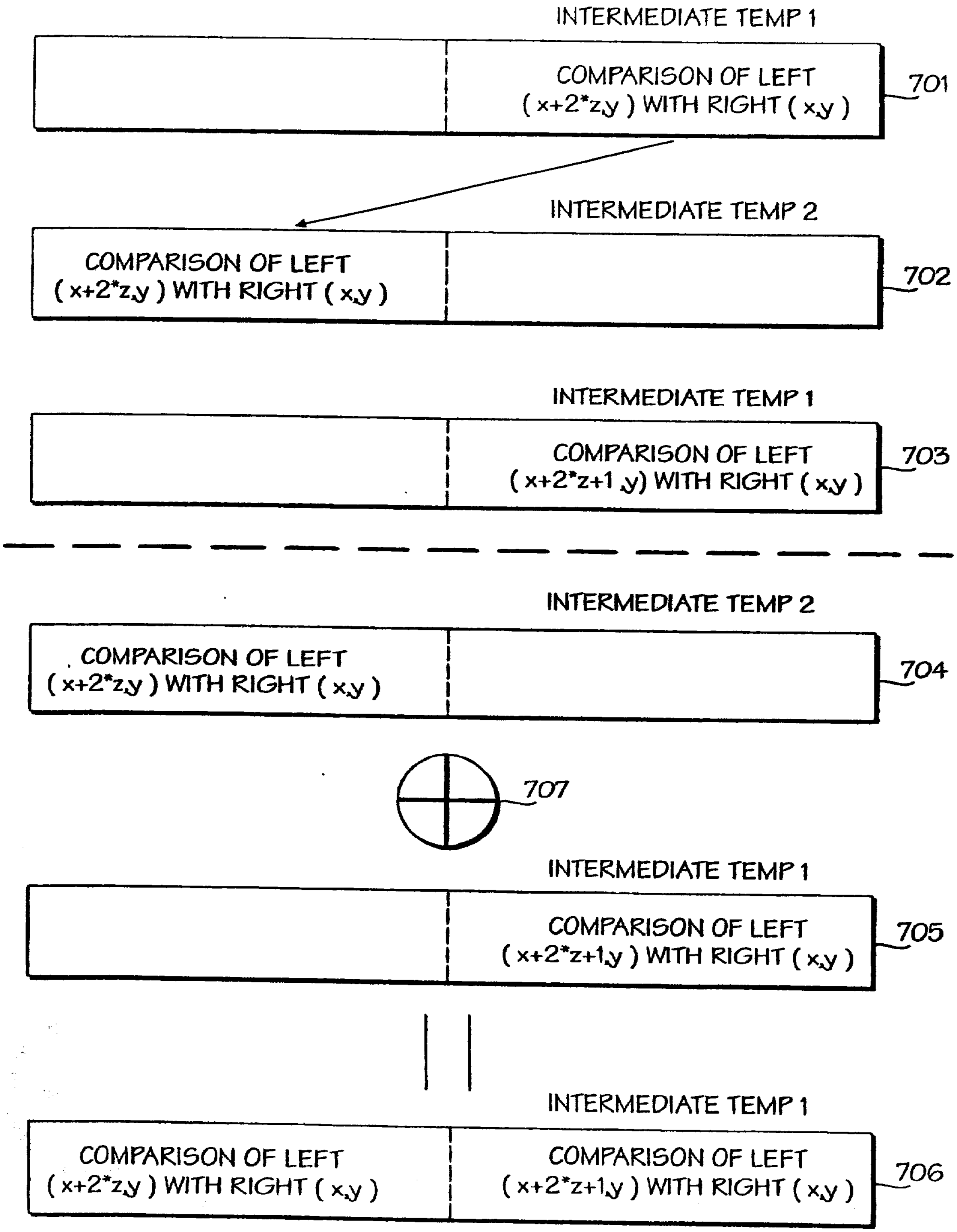


FIG. 3G

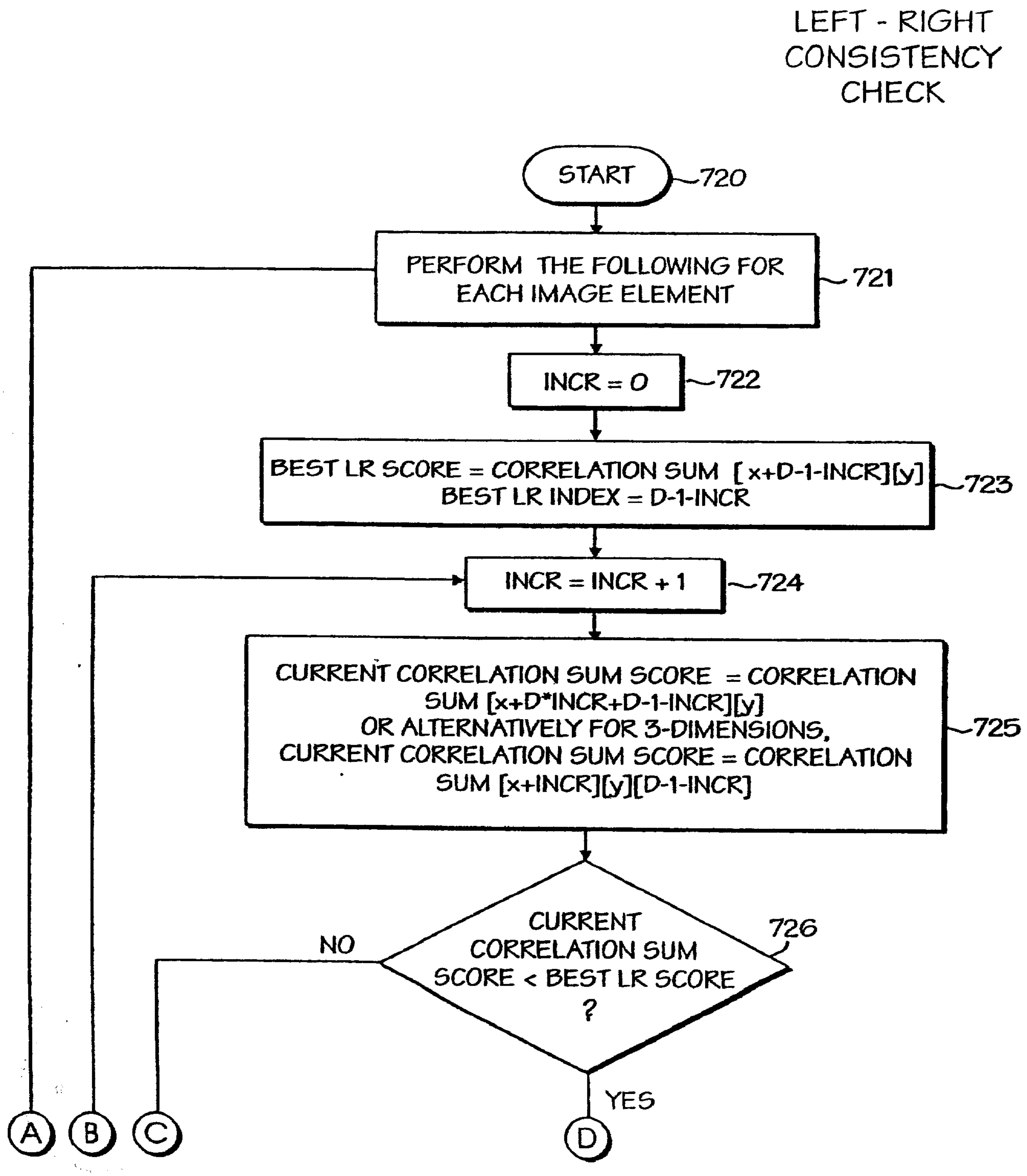

LEFT - RIGHT CONSISTENCY CHECK
START
720
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT
721
INCR = 0
722
BEST LR SCORE = CORRELATION SUM [x+D-1-INCR][y]
BEST LR INDEX = D-1-INCR
723
INCR = INCR + 1
724
CURRENT CORRELATION SUM SCORE = CORRELATION SUM [x+D*INCR+D-1-INCR][y]
OR ALTERNATIVELY FOR 3-DIMENSIONS,
CURRENT CORRELATION SUM SCORE = CORRELATION SUM [x+INCR][y][D-1-INCR]
725
CURRENT CORRELATION SUM SCORE < BEST LR SCORE ?
726
NO
YES
A
B
C
D

FIG. 37(A)

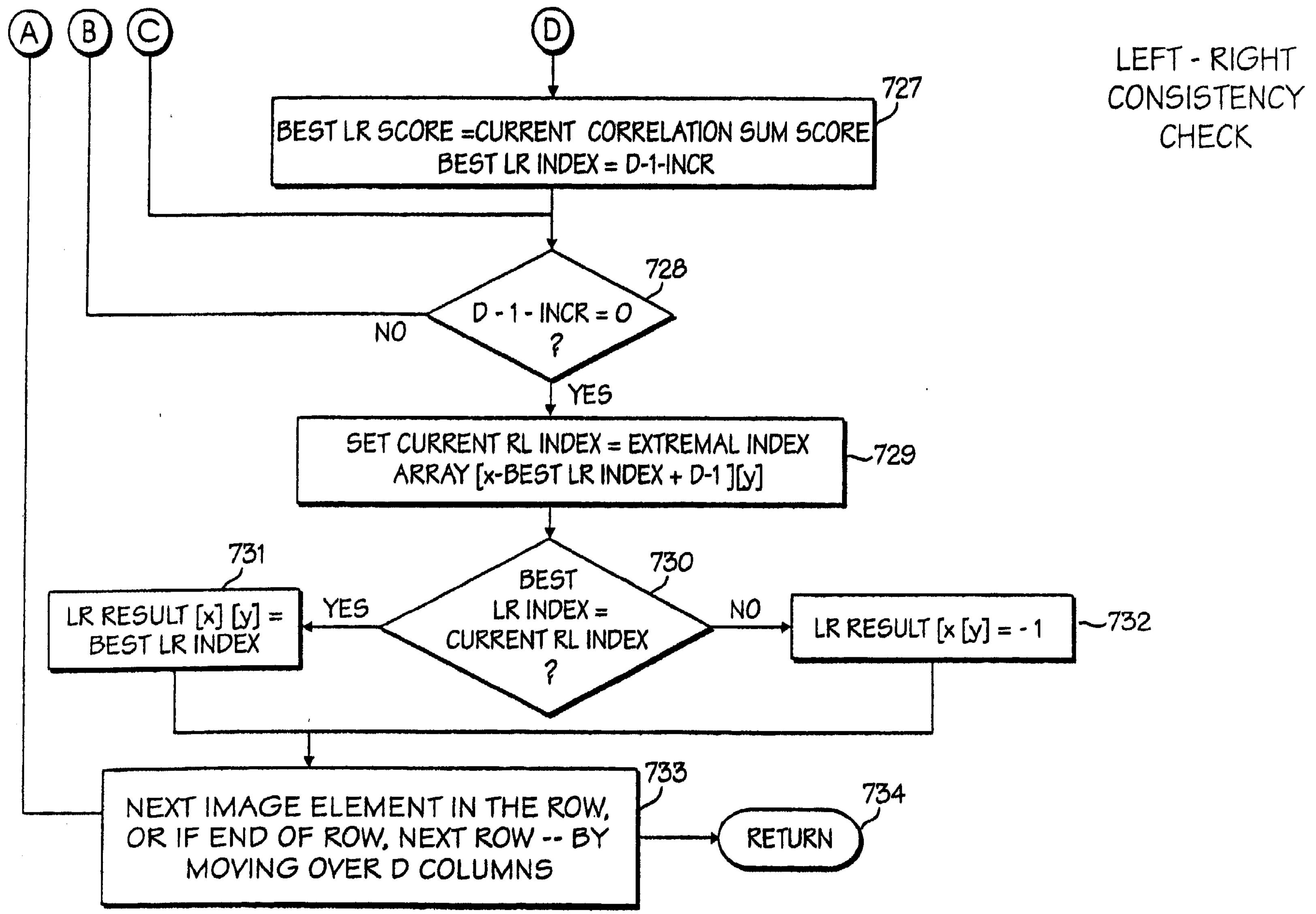

A
B
C
D
BEST LR SCORE =CURRENT CORRELATION SUM SCORE
BEST LR INDEX = D-1-INCR
727
LEFT - RIGHT
CONSISTENCY
CHECK
D - 1 - INCR = 0
?
728
NO
YES
SET CURRENT RL INDEX = EXTREMAL INDEX
ARRAY [x-BEST LR INDEX + D-1][y]
729
731
LR RESULT [x] [y] =
BEST LR INDEX
YES
BEST
LR INDEX =
CURRENT RL INDEX
?
730
NO
LR RESULT [x [y] = - 1
732
NEXT IMAGE ELEMENT IN THE ROW,
OR IF END OF ROW, NEXT ROW -- BY
MOVING OVER D COLUMNS
733
RETURN
734

FIG. 37(B)

MODE FILTER

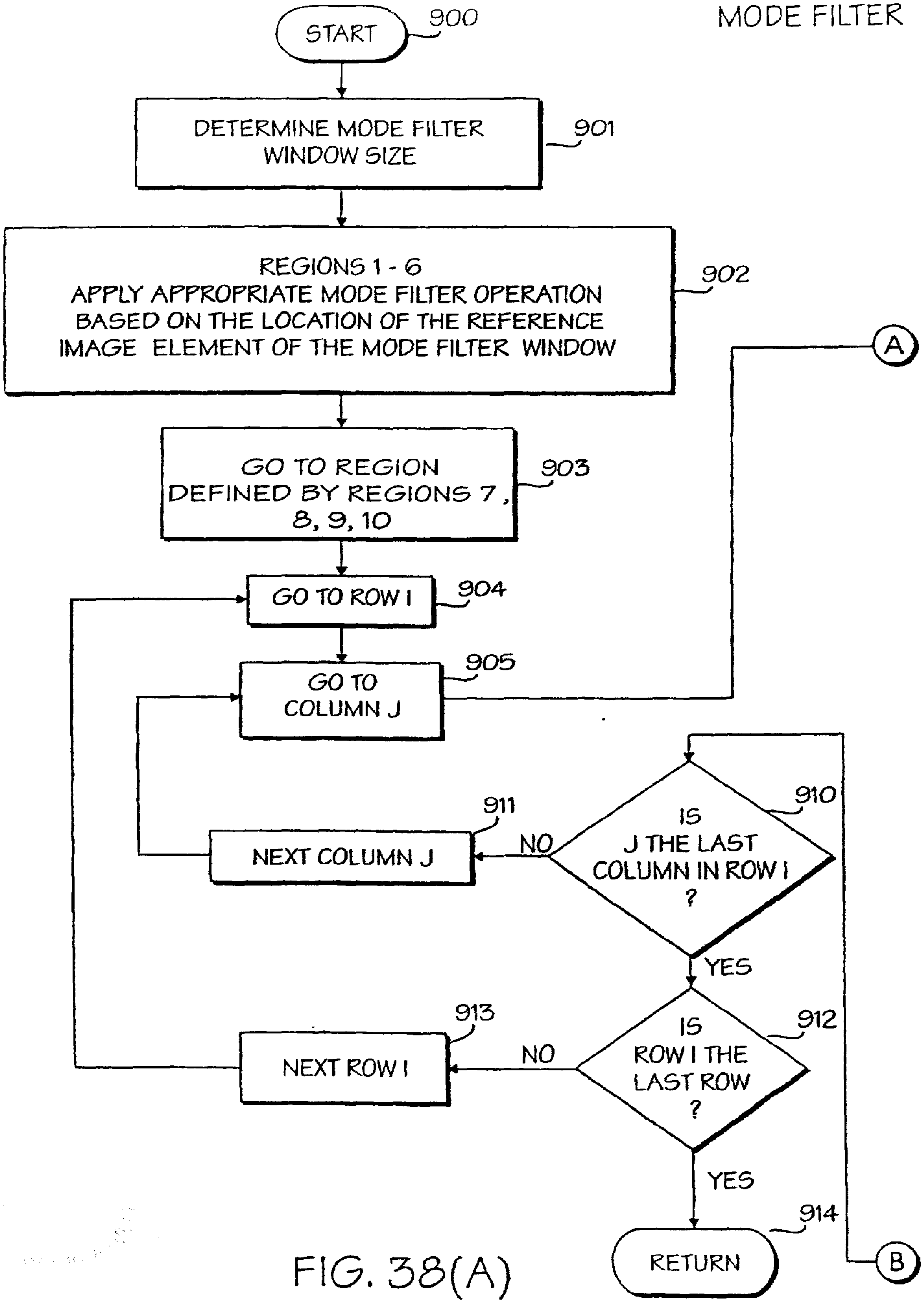


FIG. 38(A)

MODE FILTER

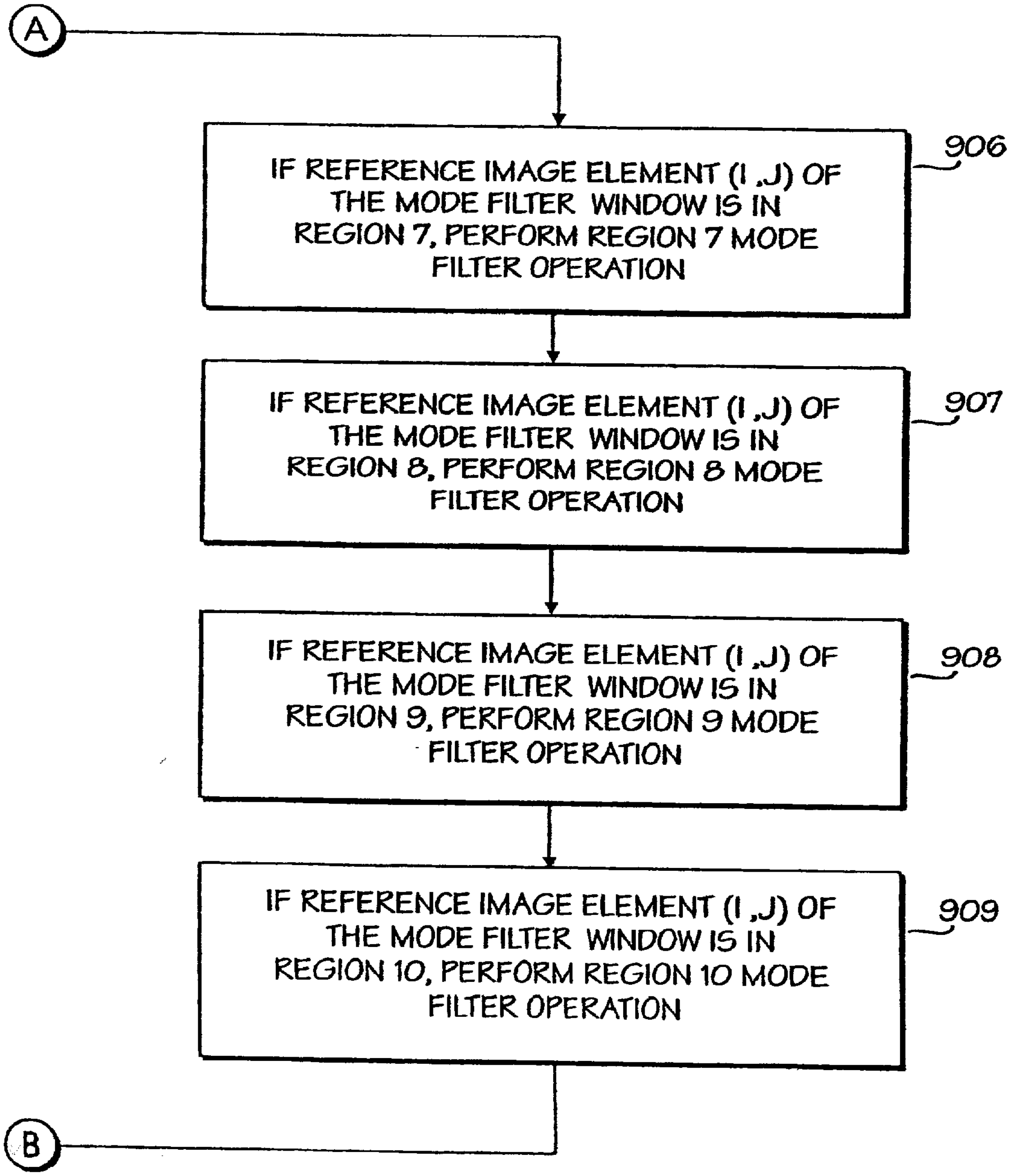


FIG. 38(B)

MODE FILTER
(REGIONS 1 & 2)

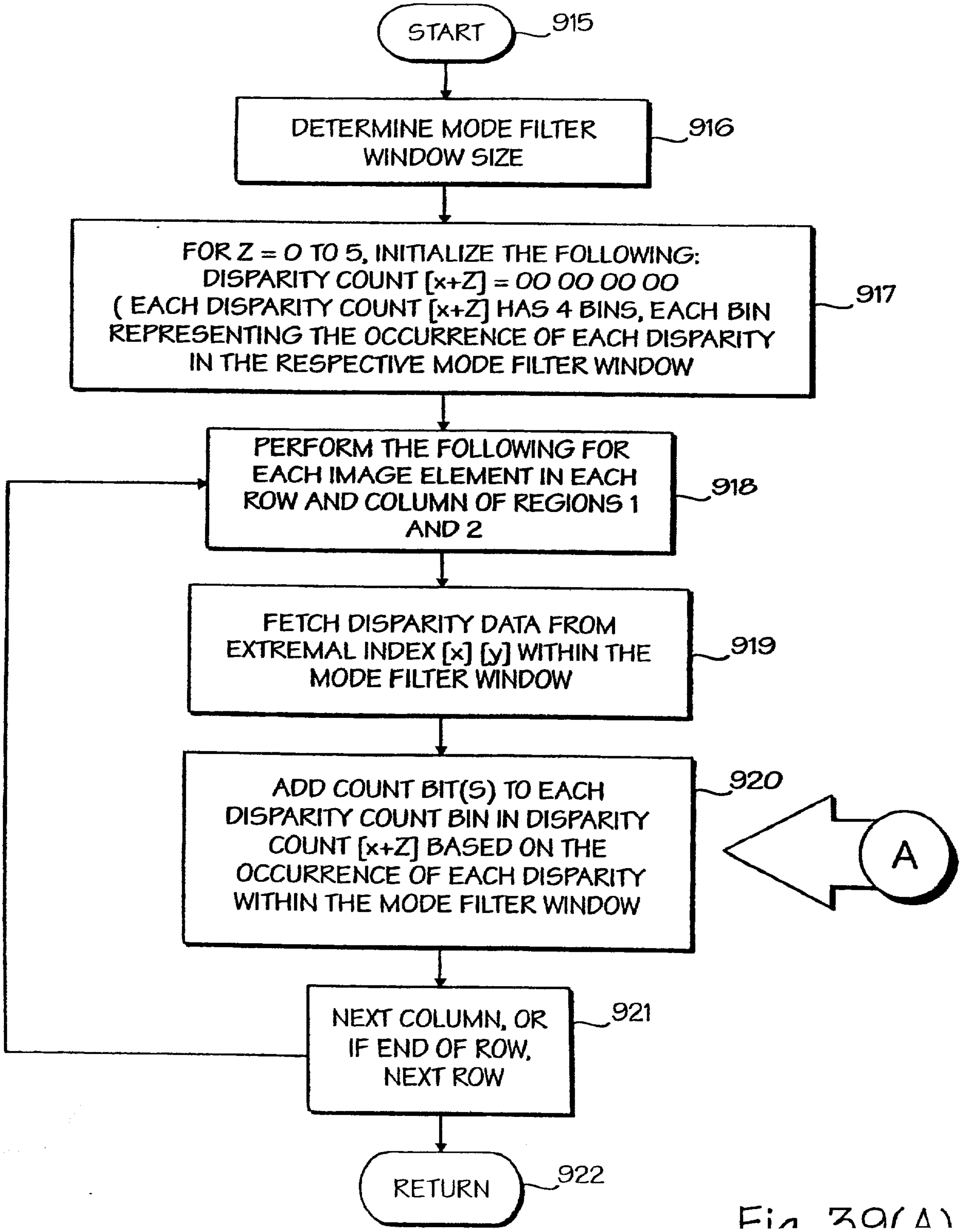
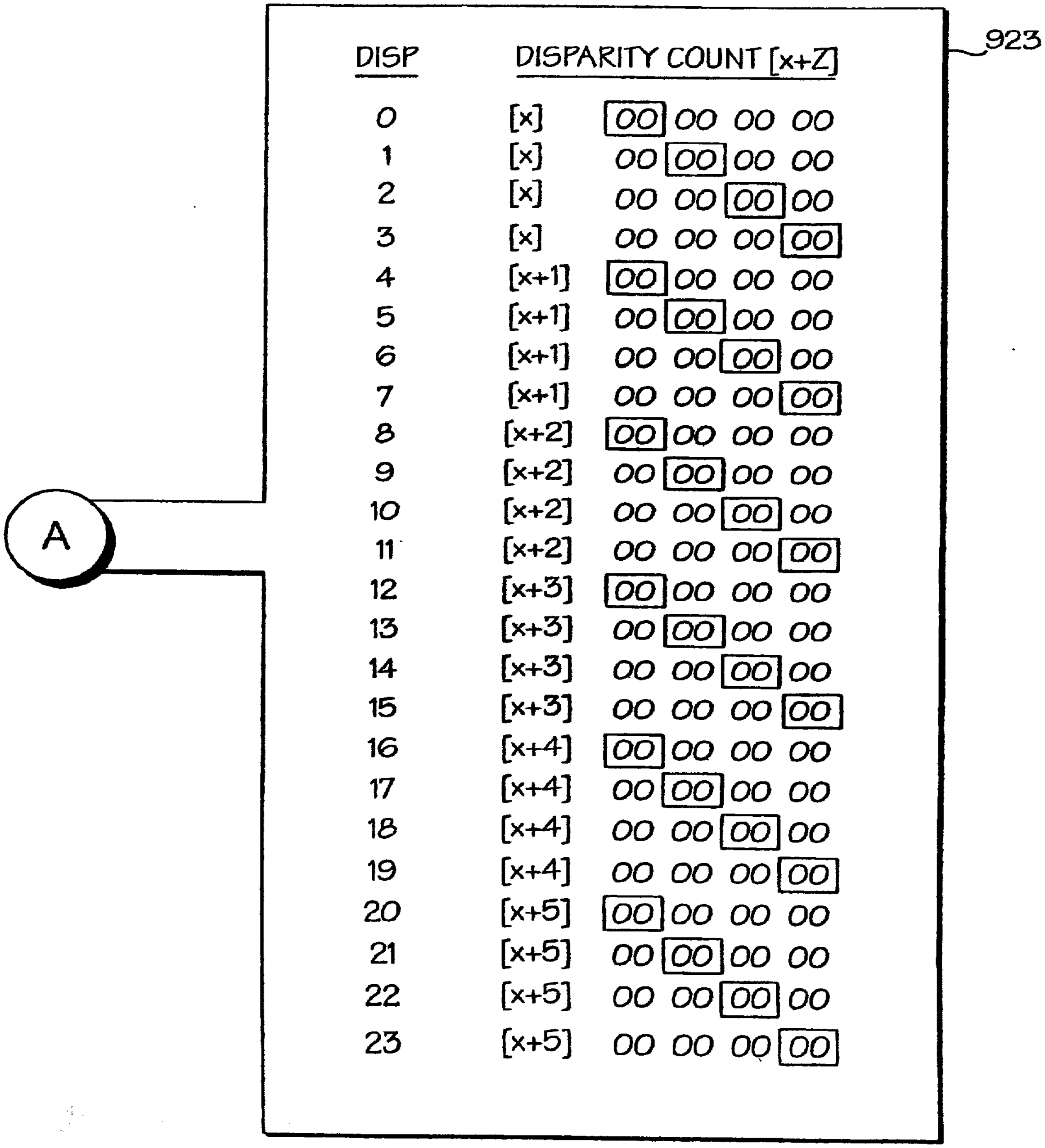


Fig. 39(A)

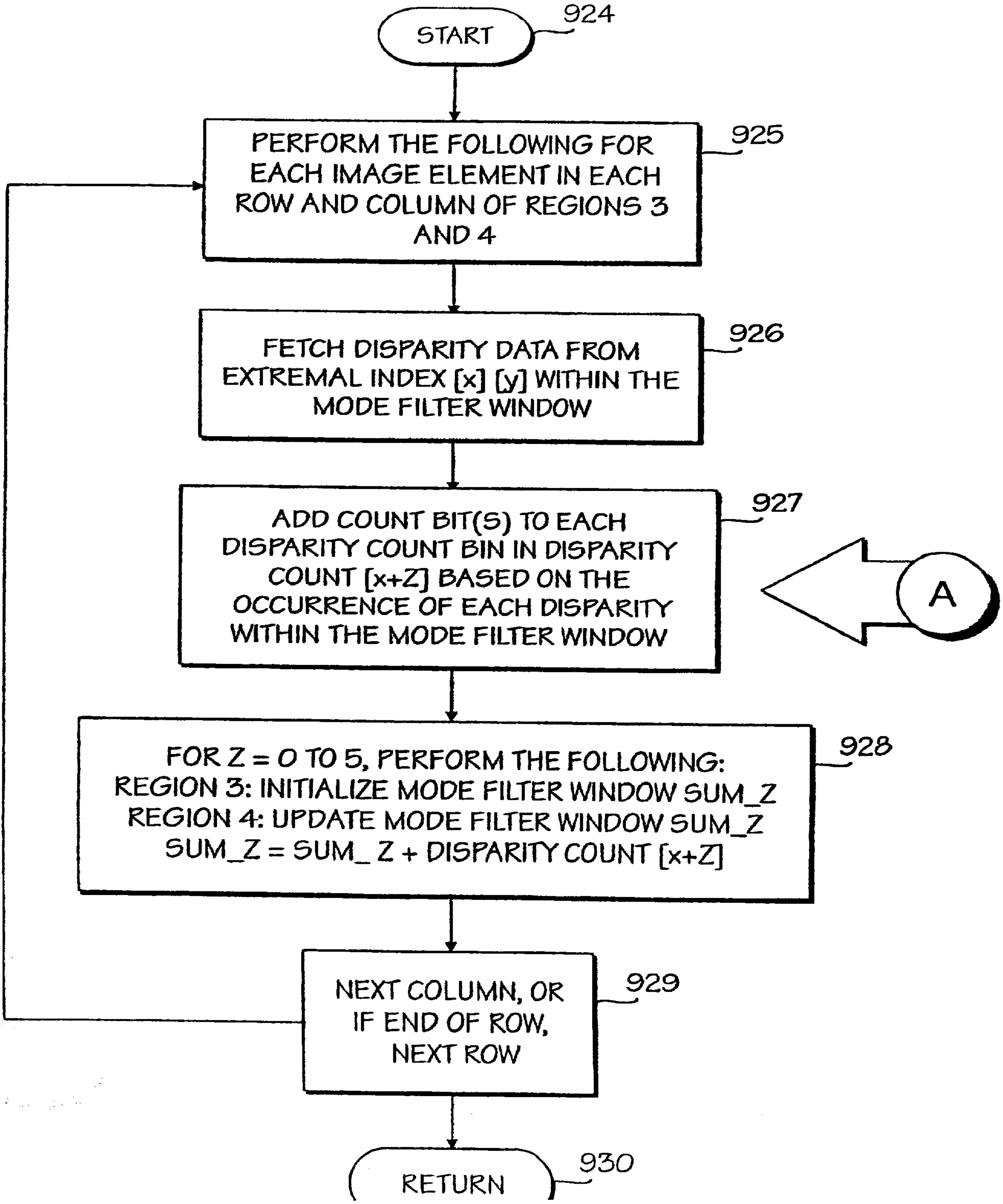
MODE FILTER
(REGIONS 1 & 2)



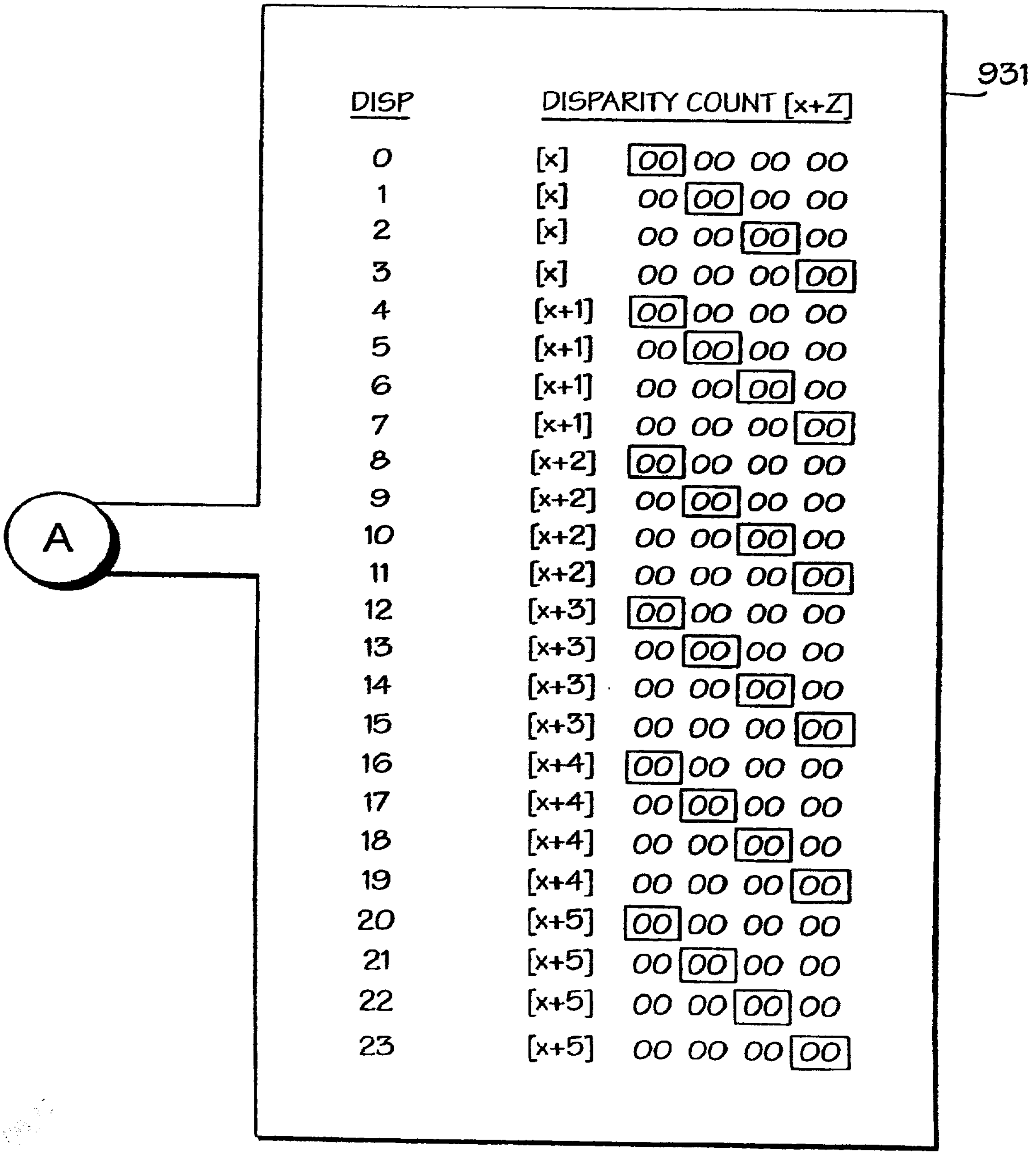
DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

Fig. 39(B)

MODE FILTER
(REGIONS 3 & 4)



MODE FILTER
(REGIONS 3 & 4)



DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

FIG 40(B)

MODE FILTER
(REGION 5)

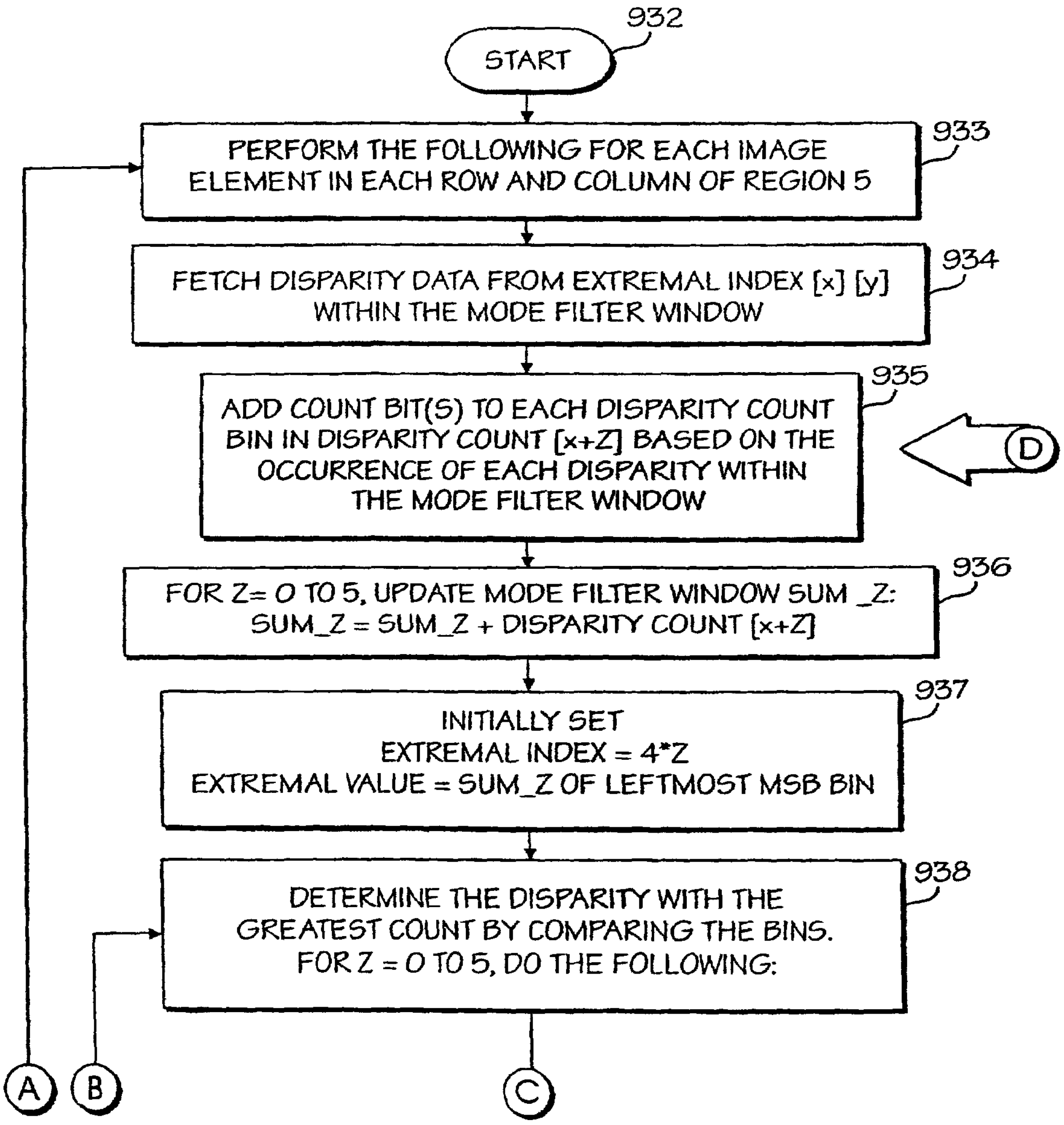
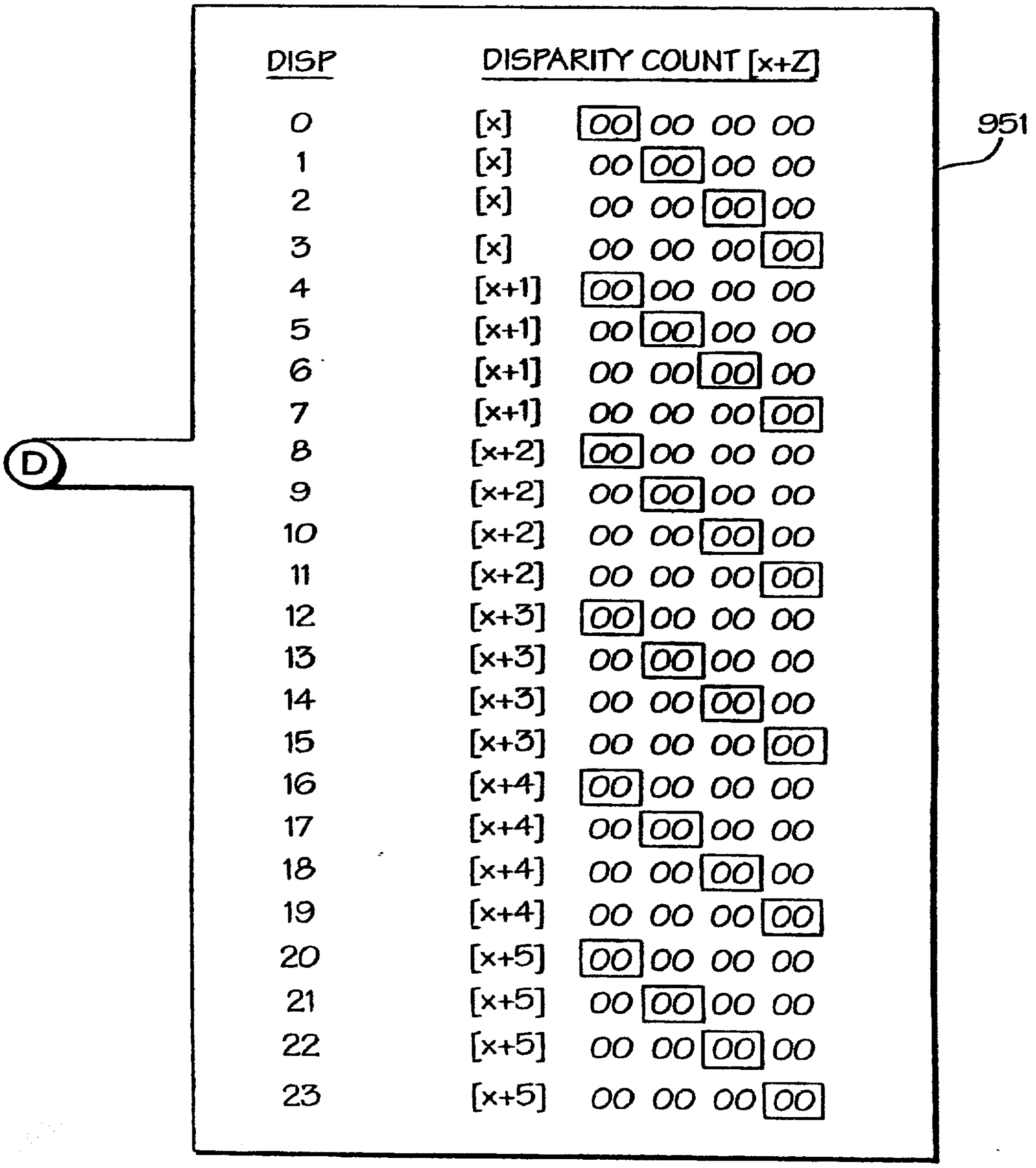


FIG. 41(A)

MODE FILTER
(REGION 5)



DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

FIG. 41(B)

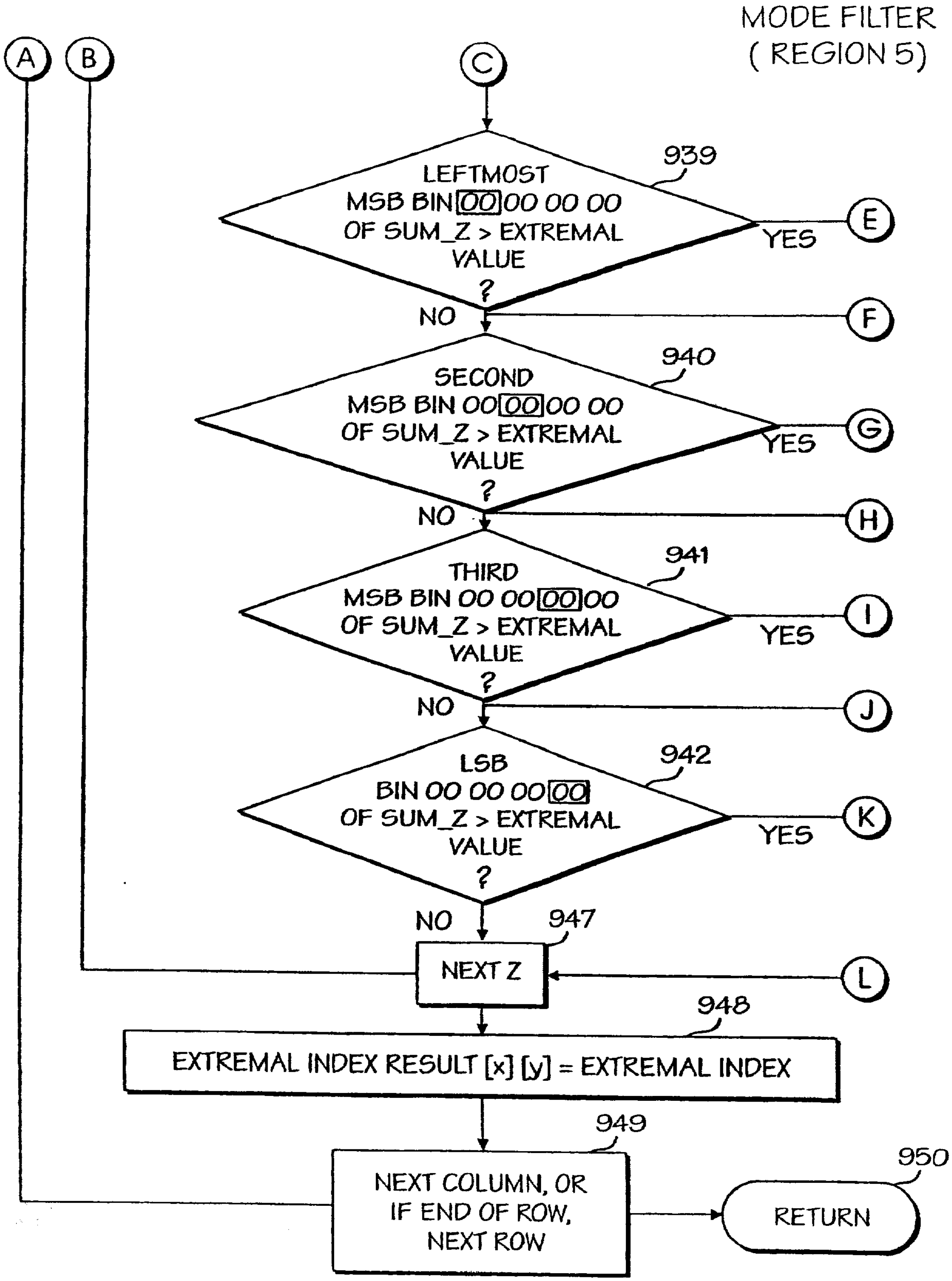

MODE FILTER
(REGION 5)
A
B
C
939
LEFTMOST MSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
YES
E
NO
F
940
SECOND MSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
YES
G
NO
H
941
THIRD MSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
YES
I
NO
J
942
LSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
YES
K
NO
947
NEXT Z
L
948
EXTREMAL INDEX RESULT [x] [y] = EXTREMAL INDEX
949
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
950
RETURN

FIG 41(C)

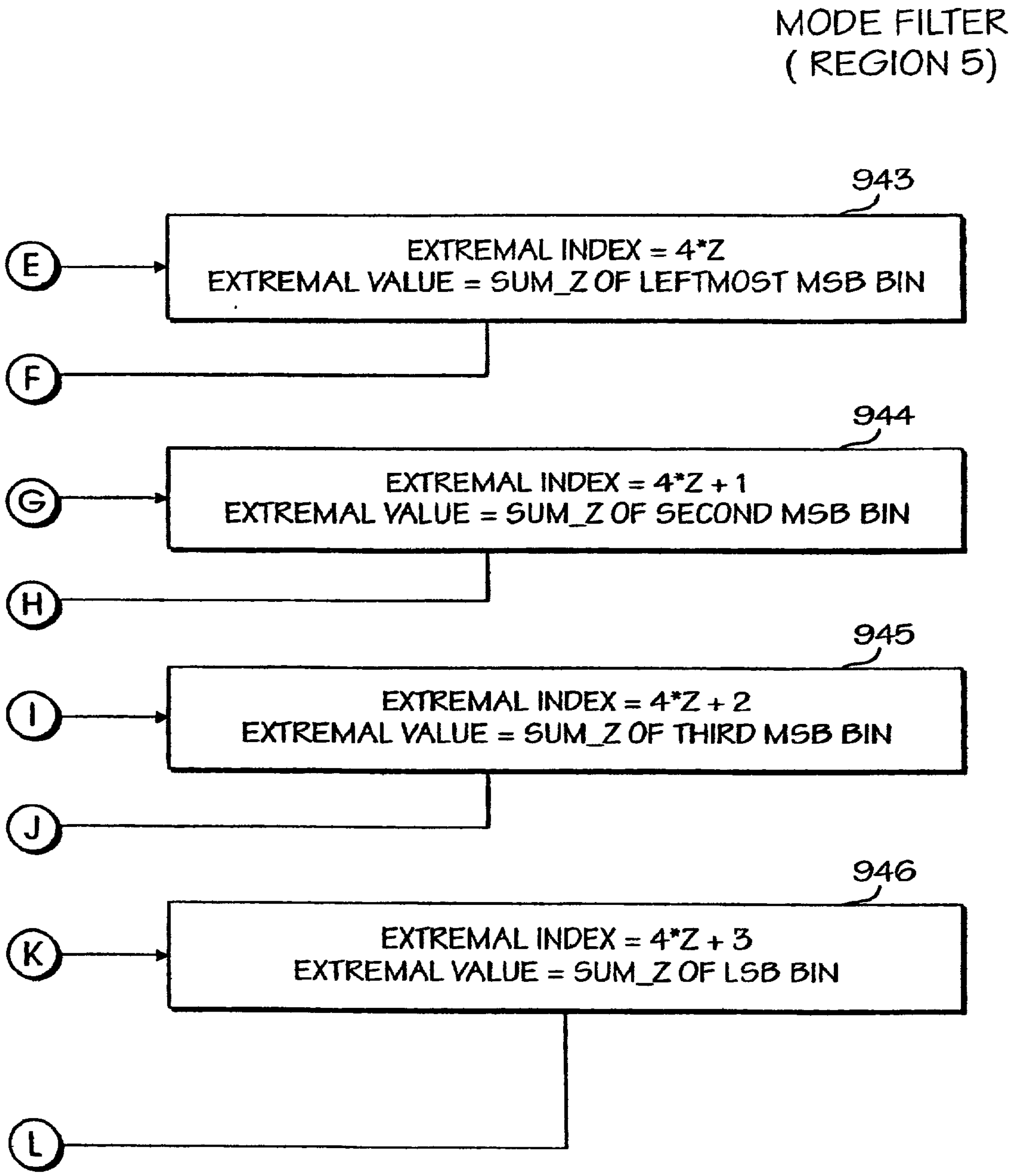

MODE FILTER
(REGION 5)
943
E
EXTREMAL INDEX = 4*Z
EXTREMAL VALUE = SUM_Z OF LEFTMOST MSB BIN
F
944
G
EXTREMAL INDEX = 4*Z + 1
EXTREMAL VALUE = SUM_Z OF SECOND MSB BIN
H
945
I
EXTREMAL INDEX = 4*Z + 2
EXTREMAL VALUE = SUM_Z OF THIRD MSB BIN
J
946
K
EXTREMAL INDEX = 4*Z + 3
EXTREMAL VALUE = SUM_Z OF LSB BIN
L

FIG. 41(D)

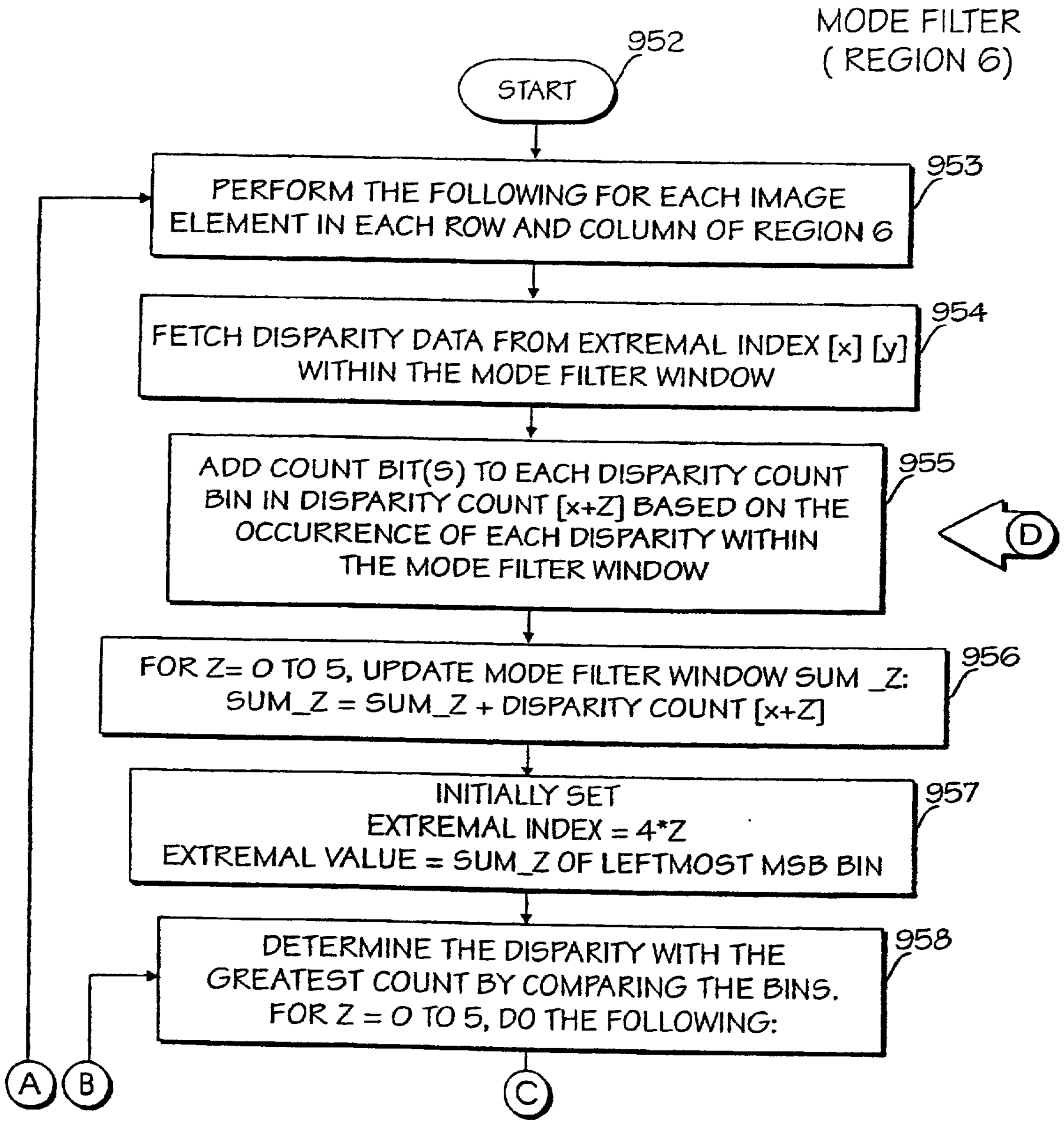
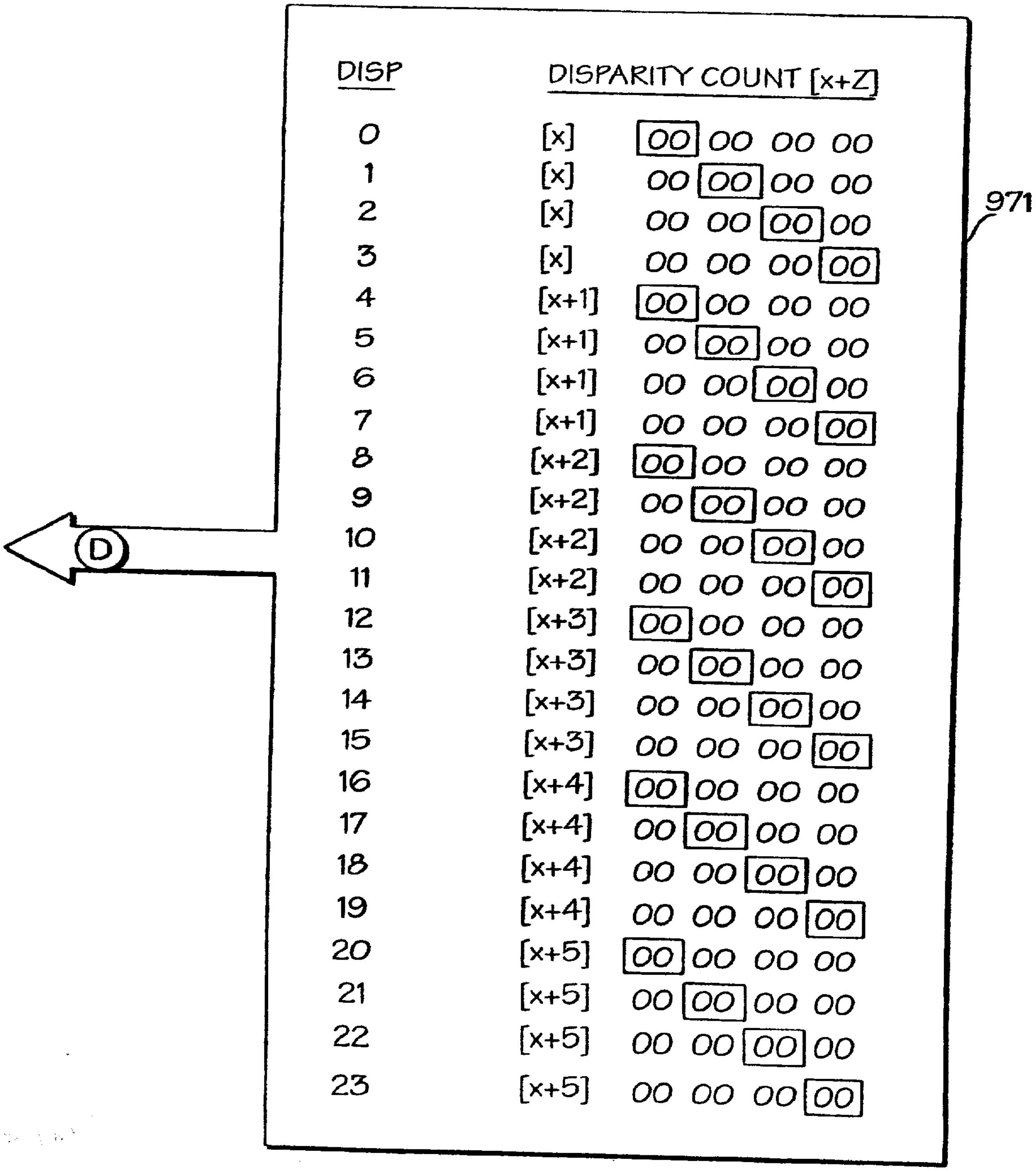

MODE FILTER
(REGION 6)
952
START
953
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT IN EACH ROW AND COLUMN OF REGION 6
954
FETCH DISPARITY DATA FROM EXTREMAL INDEX [x] [y] WITHIN THE MODE FILTER WINDOW
955
ADD COUNT BIT(S) TO EACH DISPARITY COUNT BIN IN DISPARITY COUNT [x+Z] BASED ON THE OCCURRENCE OF EACH DISPARITY WITHIN THE MODE FILTER WINDOW
D
956
FOR Z= 0 TO 5, UPDATE MODE FILTER WINDOW SUM _Z:
SUM_Z = SUM_Z + DISPARITY COUNT [x+Z]
957
INITIALLY SET
EXTREMAL INDEX = 4*Z
EXTREMAL VALUE = SUM_Z OF LEFTMOST MSB BIN
958
DETERMINE THE DISPARITY WITH THE GREATEST COUNT BY COMPARING THE BINS.
FOR Z = 0 TO 5, DO THE FOLLOWING:
A
B
C

FIG. 42(A)

MODE FILTER
(REGION 6)



DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

FIG. 42(B)

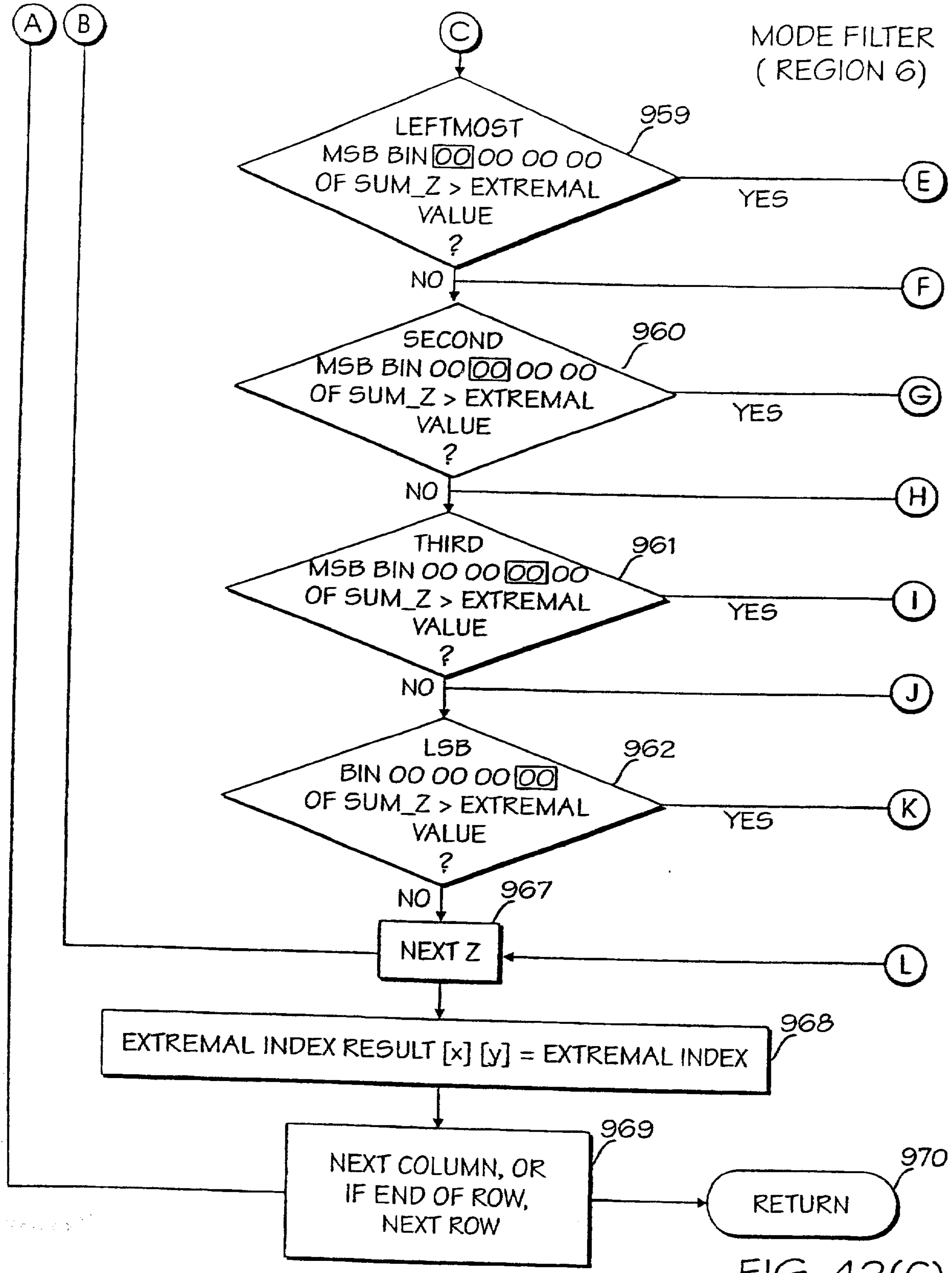

MODE FILTER
(REGION 6)
A
B
C
LEFTMOST
MSB BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
959
YES
E
NO
F
SECOND
MSB BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
960
YES
G
NO
H
THIRD
MSB BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
961
YES
I
NO
J
LSB
BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
962
YES
K
NO
967
NEXT Z
L
EXTREMAL INDEX RESULT [x] [y] = EXTREMAL INDEX
968
NEXT COLUMN, OR
IF END OF ROW,
NEXT ROW
969
RETURN
970

FIG. 42(C)

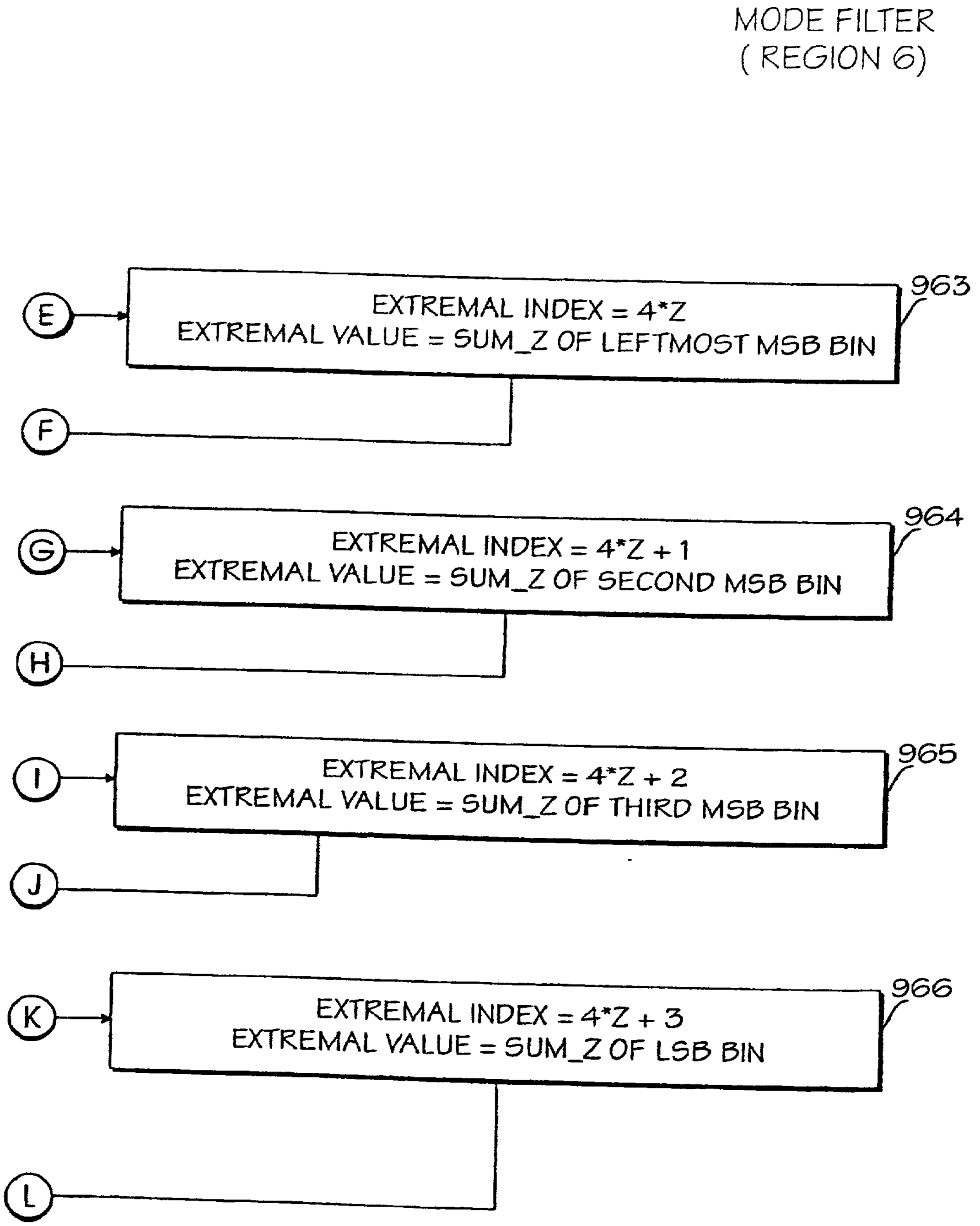

MODE FILTER
(REGION 6)
E
EXTREMAL INDEX = 4*Z
EXTREMAL VALUE = SUM_Z OF LEFTMOST MSB BIN
963
F
G
EXTREMAL INDEX = 4*Z + 1
EXTREMAL VALUE = SUM_Z OF SECOND MSB BIN
964
H
I
EXTREMAL INDEX = 4*Z + 2
EXTREMAL VALUE = SUM_Z OF THIRD MSB BIN
965
J
K
EXTREMAL INDEX = 4*Z + 3
EXTREMAL VALUE = SUM_Z OF LSB BIN
966
L

FIG. 42(D)

MODE FILTER
(REGIONS 7 & 8)

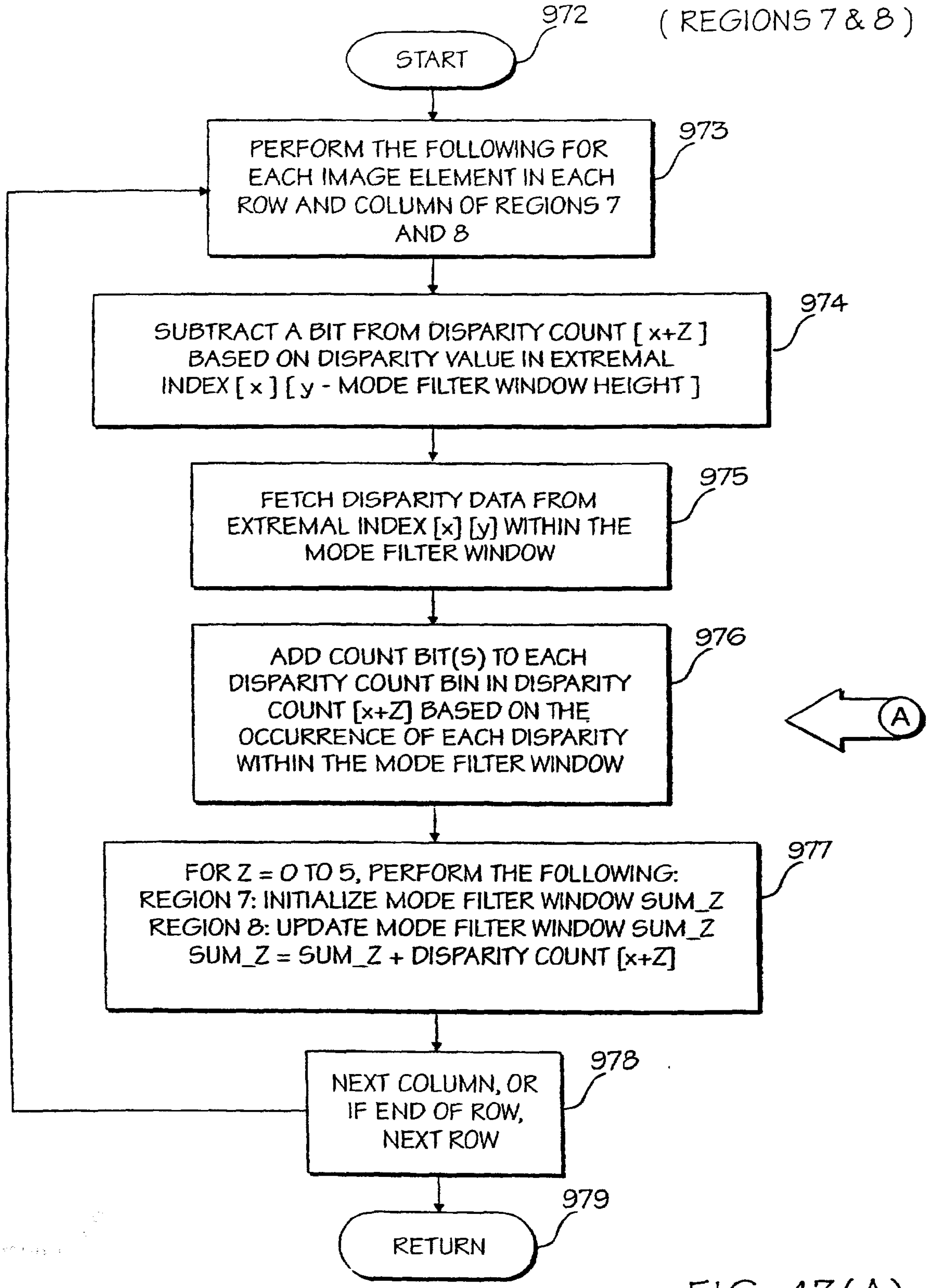
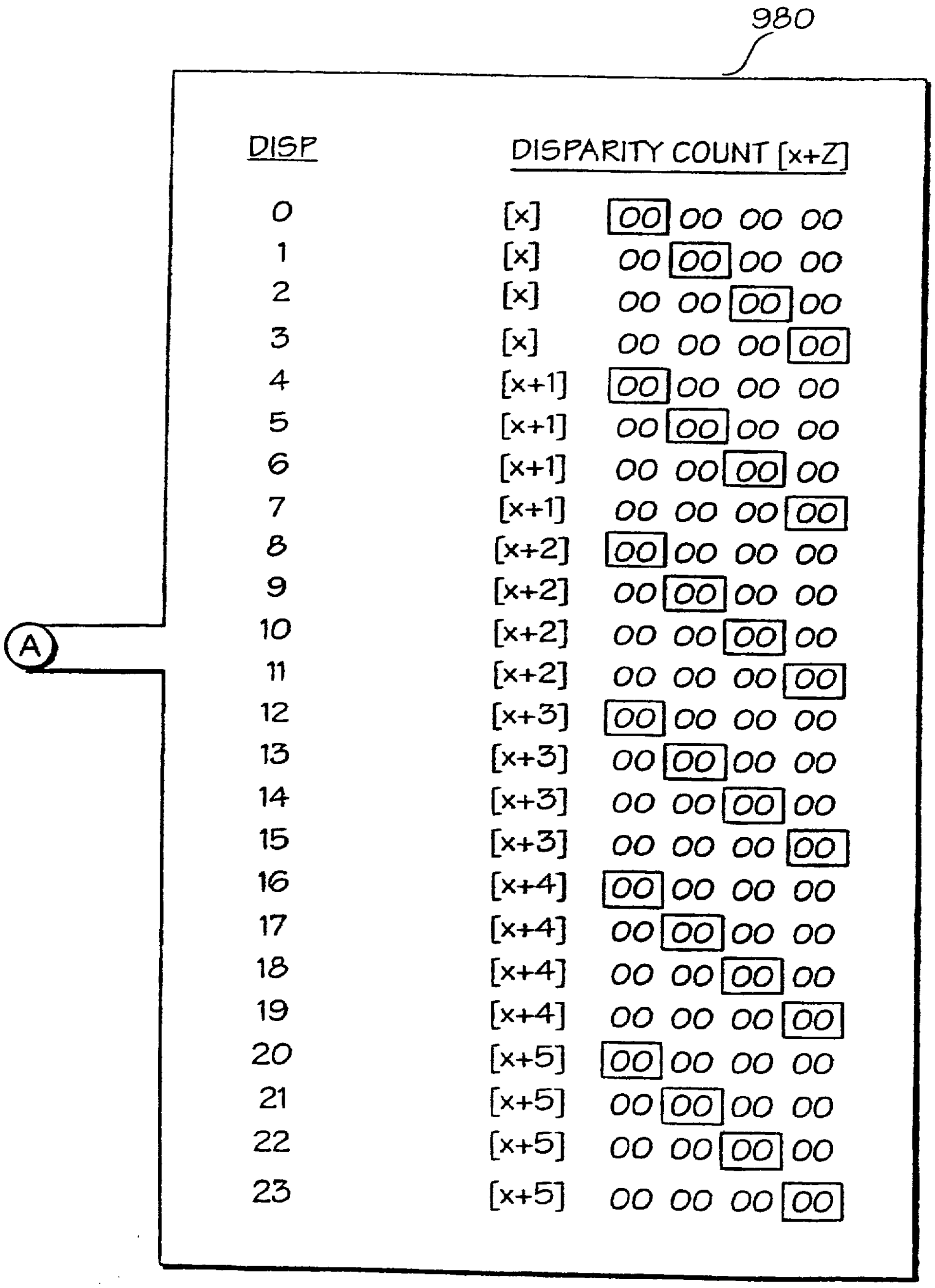


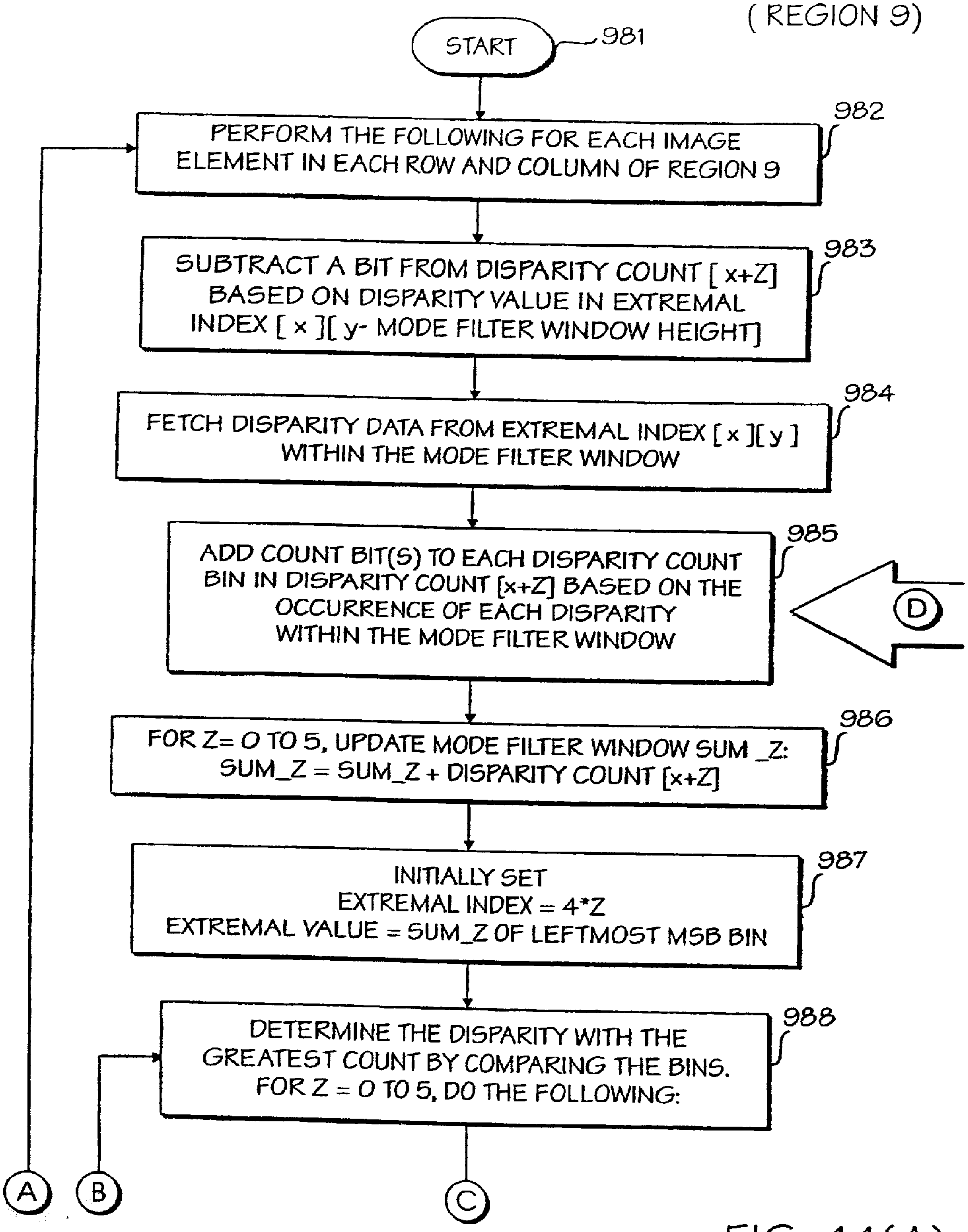
FIG. 43(A)

MODE FILTER
(REGIONS 7 & 8)



DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

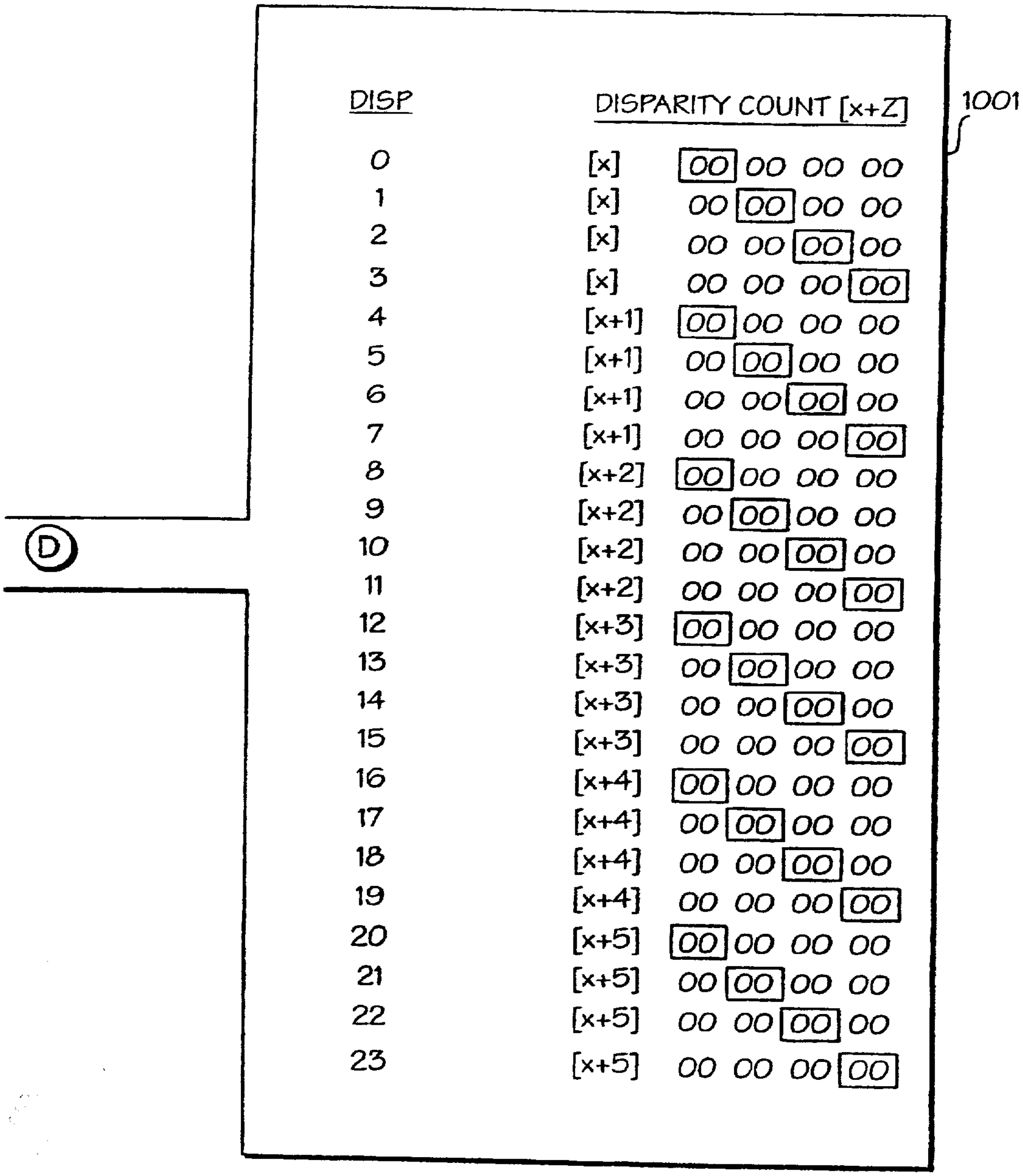
FIG. 43(B)



MODE FILTER
(REGION 9)

FIG. 44(A)

MODE FILTER
(REGION 9)



DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

FIG. 44(B)

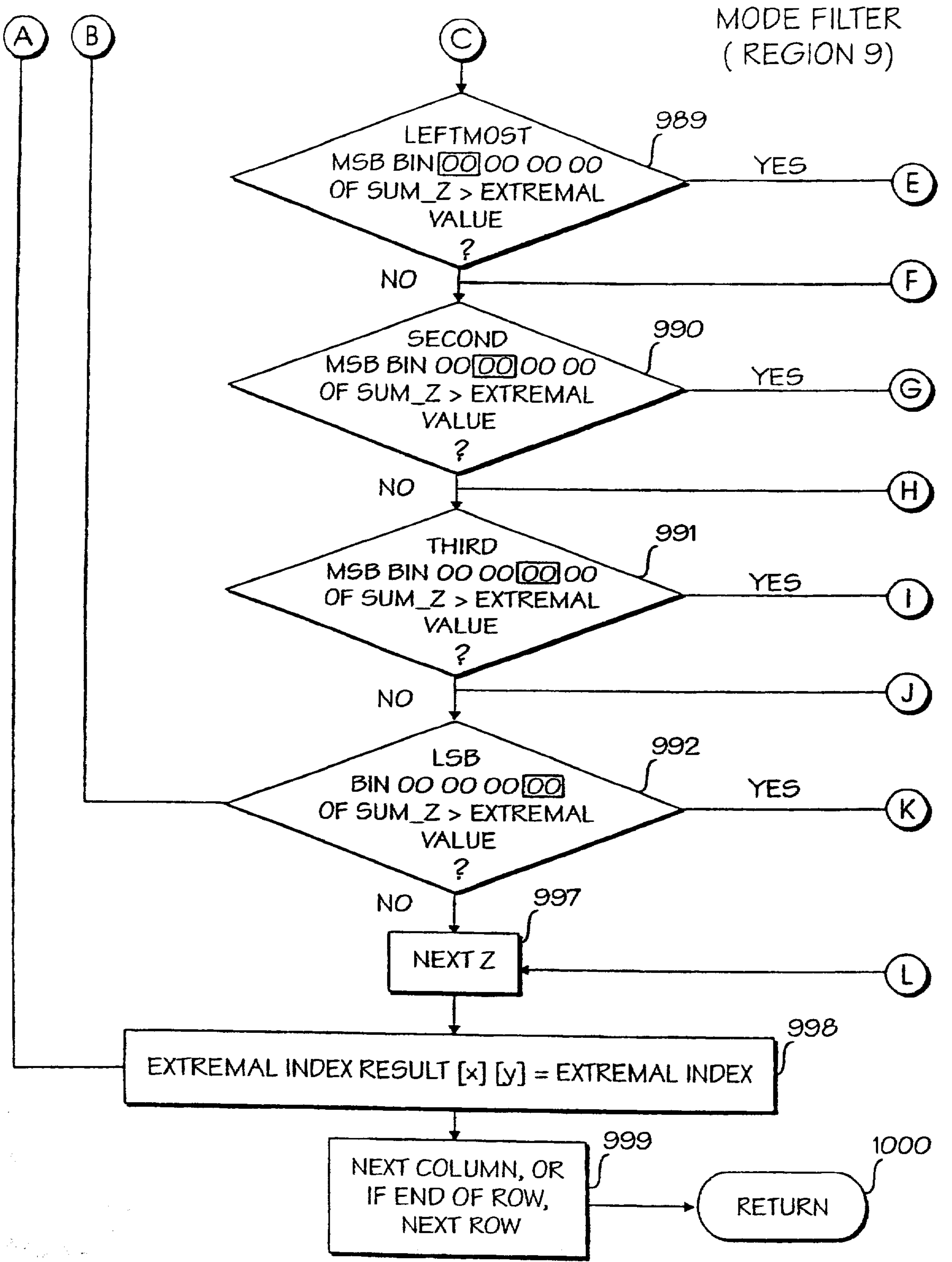

MODE FILTER
(REGION 9)
A
B
C
LEFTMOST
MSB BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
989
YES
E
NO
F
SECOND
MSB BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
990
YES
G
NO
H
THIRD
MSB BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
991
YES
I
NO
J
LSB
BIN 00 00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
992
YES
K
NO
997
NEXT Z
L
EXTREMAL INDEX RESULT [x] [y] = EXTREMAL INDEX
998
NEXT COLUMN, OR
IF END OF ROW,
NEXT ROW
999
RETURN
1000

FIG. 44(C)

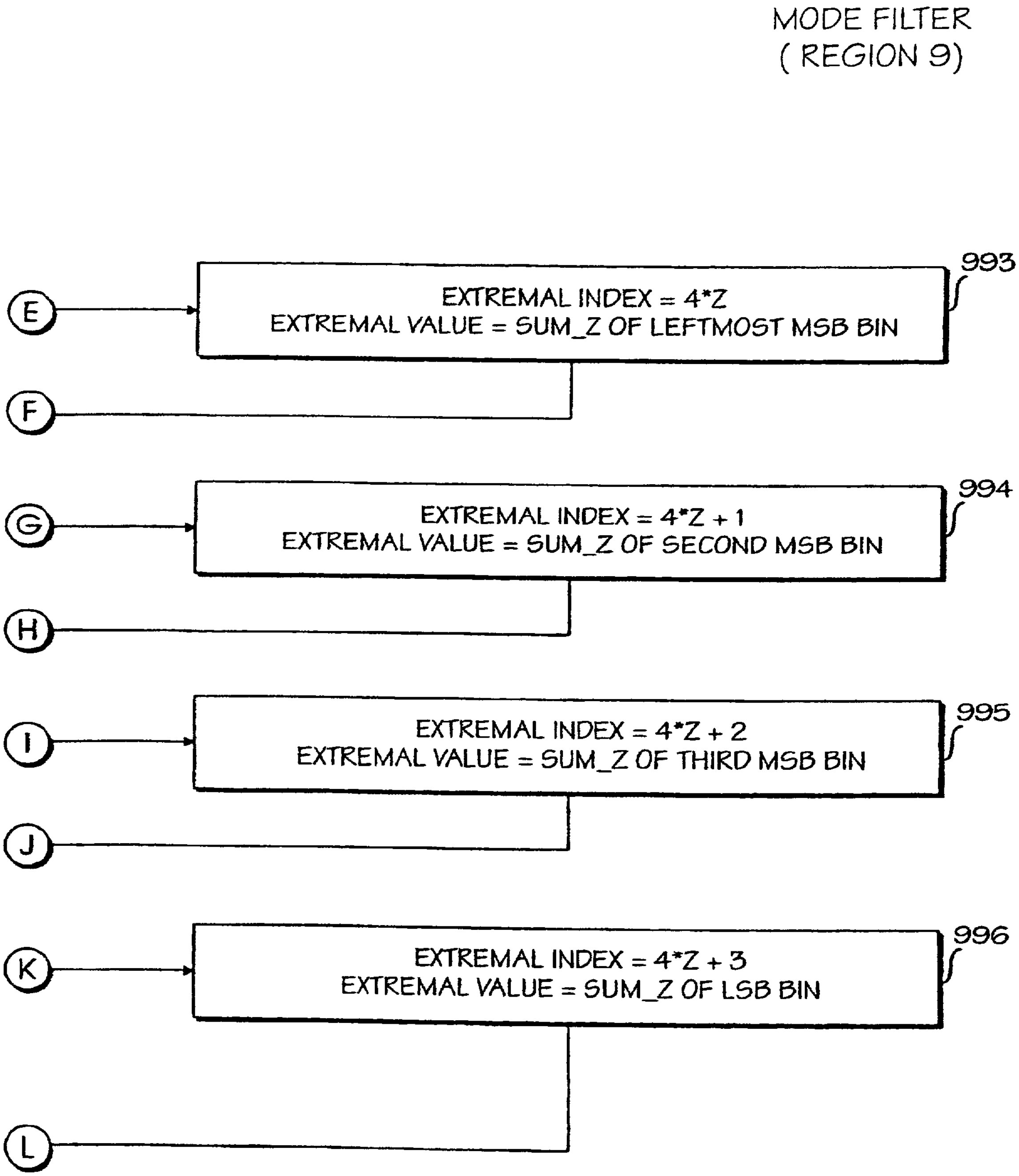

MODE FILTER
(REGION 9)
E
F
G
H
I
J
K
L
EXTREMAL INDEX = 4*Z
EXTREMAL VALUE = SUM_Z OF LEFTMOST MSB BIN
993
EXTREMAL INDEX = 4*Z + 1
EXTREMAL VALUE = SUM_Z OF SECOND MSB BIN
994
EXTREMAL INDEX = 4*Z + 2
EXTREMAL VALUE = SUM_Z OF THIRD MSB BIN
995
EXTREMAL INDEX = 4*Z + 3
EXTREMAL VALUE = SUM_Z OF LSB BIN
996

FIG. 44(D)

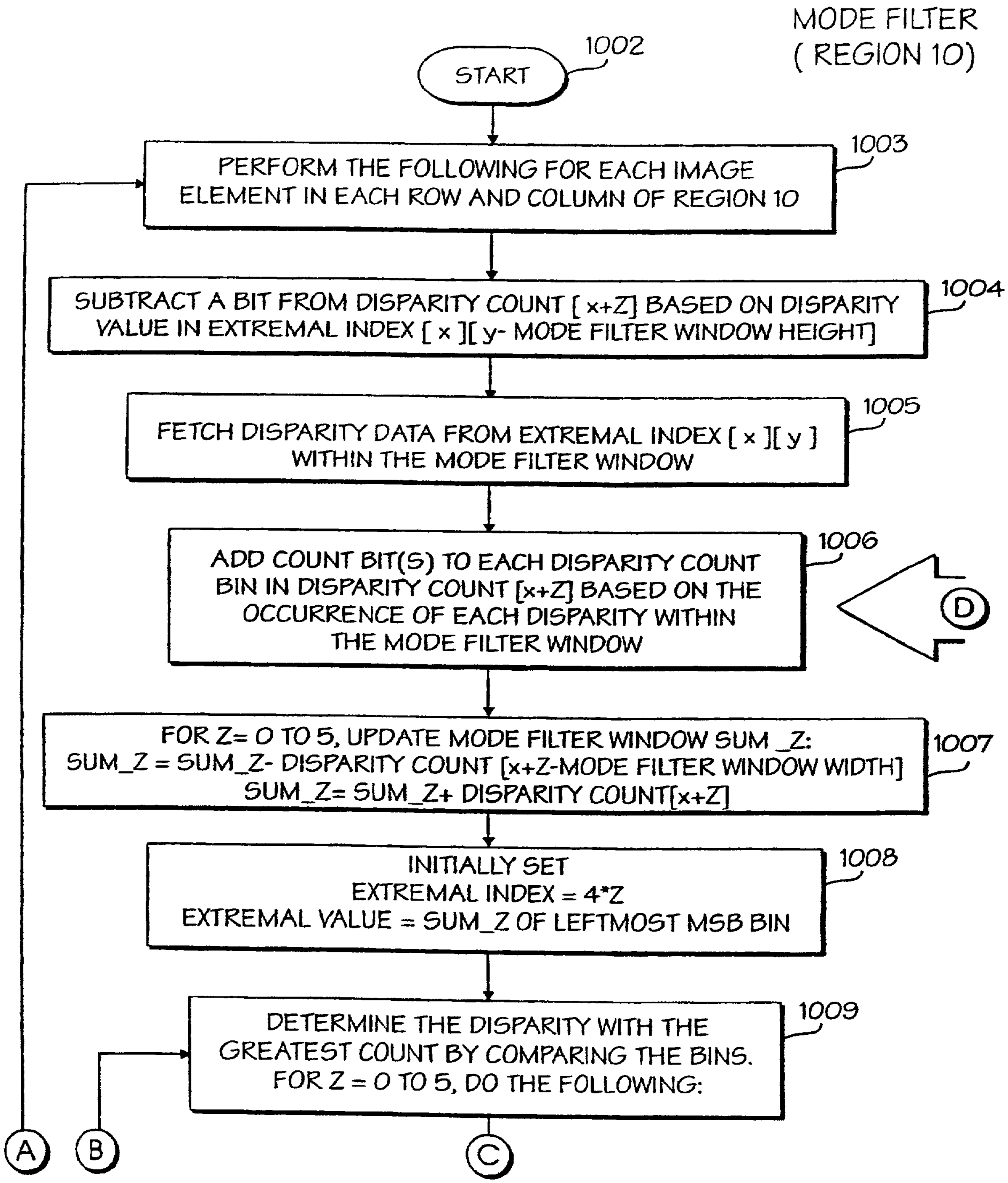
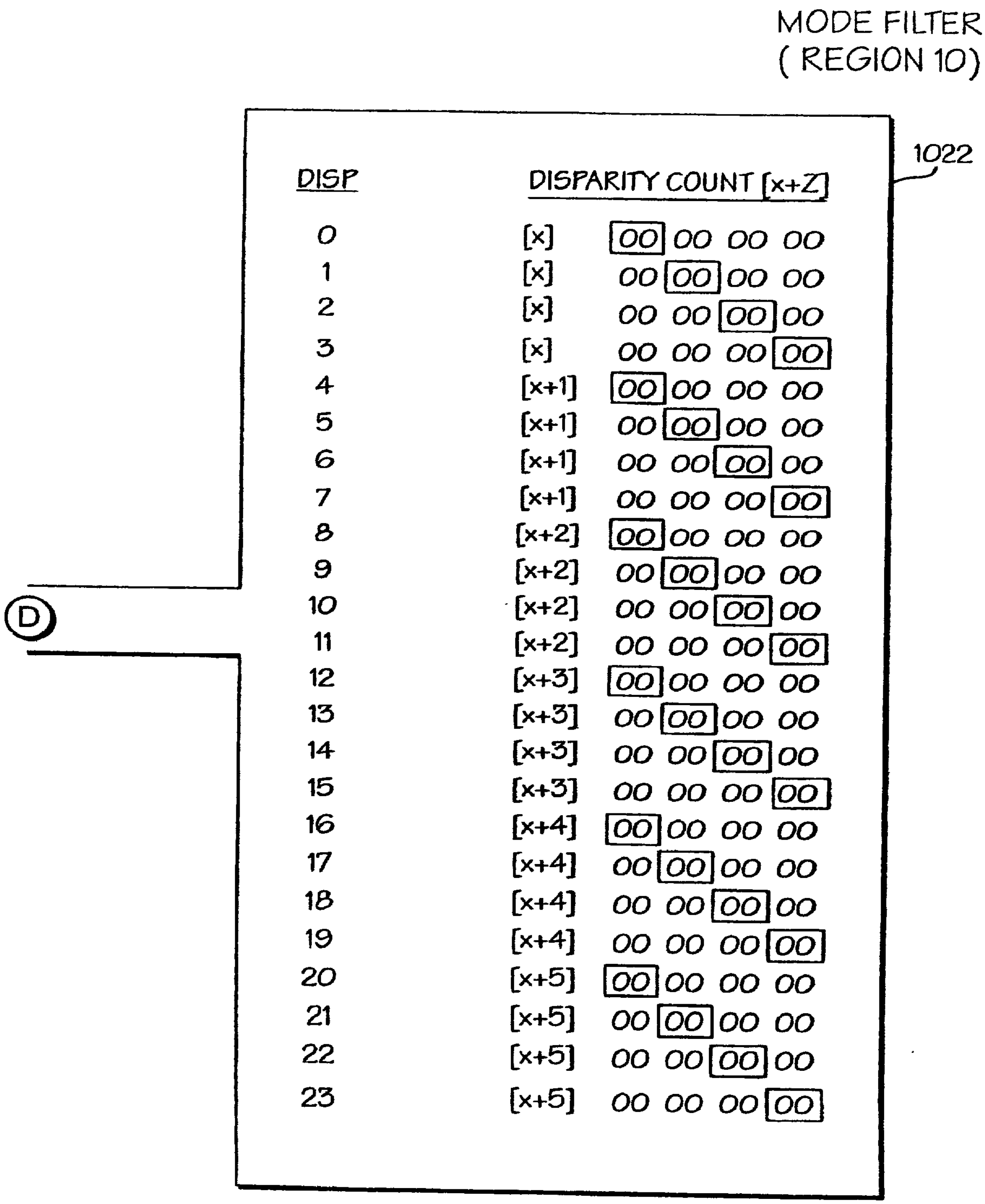

MODE FILTER
(REGION 10)
START
1002
PERFORM THE FOLLOWING FOR EACH IMAGE ELEMENT IN EACH ROW AND COLUMN OF REGION 10
1003
SUBTRACT A BIT FROM DISPARITY COUNT [x+Z] BASED ON DISPARITY VALUE IN EXTREMAL INDEX [x][y- MODE FILTER WINDOW HEIGHT]
1004
FETCH DISPARITY DATA FROM EXTREMAL INDEX [x][y] WITHIN THE MODE FILTER WINDOW
1005
ADD COUNT BIT(S) TO EACH DISPARITY COUNT BIN IN DISPARITY COUNT [x+Z] BASED ON THE OCCURRENCE OF EACH DISPARITY WITHIN THE MODE FILTER WINDOW
1006
D
FOR Z= 0 TO 5, UPDATE MODE FILTER WINDOW SUM _Z:
SUM_Z = SUM_Z- DISPARITY COUNT [x+Z-MODE FILTER WINDOW WIDTH]
SUM_Z= SUM_Z+ DISPARITY COUNT[x+Z]
1007
INITIALLY SET
EXTREMAL INDEX = 4*Z
EXTREMAL VALUE = SUM_Z OF LEFTMOST MSB BIN
1008
DETERMINE THE DISPARITY WITH THE GREATEST COUNT BY COMPARING THE BINS. FOR Z = 0 TO 5, DO THE FOLLOWING:
1009
A
B
C

FIG. 45(A)



DISP	DISPARITY COUNT [x+Z]				
0	[x]	$\boxed{00}$	00	00	00
1	[x]	00	$\boxed{00}$	00	00
2	[x]	00	00	$\boxed{00}$	00
3	[x]	00	00	00	$\boxed{00}$
4	[x+1]	$\boxed{00}$	00	00	00
5	[x+1]	00	$\boxed{00}$	00	00
6	[x+1]	00	00	$\boxed{00}$	00
7	[x+1]	00	00	00	$\boxed{00}$
8	[x+2]	$\boxed{00}$	00	00	00
9	[x+2]	00	$\boxed{00}$	00	00
10	[x+2]	00	00	$\boxed{00}$	00
11	[x+2]	00	00	00	$\boxed{00}$
12	[x+3]	$\boxed{00}$	00	00	00
13	[x+3]	00	$\boxed{00}$	00	00
14	[x+3]	00	00	$\boxed{00}$	00
15	[x+3]	00	00	00	$\boxed{00}$
16	[x+4]	$\boxed{00}$	00	00	00
17	[x+4]	00	$\boxed{00}$	00	00
18	[x+4]	00	00	$\boxed{00}$	00
19	[x+4]	00	00	00	$\boxed{00}$
20	[x+5]	$\boxed{00}$	00	00	00
21	[x+5]	00	$\boxed{00}$	00	00
22	[x+5]	00	00	$\boxed{00}$	00
23	[x+5]	00	00	00	$\boxed{00}$

FIG. 45(B)

MODE FILTER
(REGION 10)

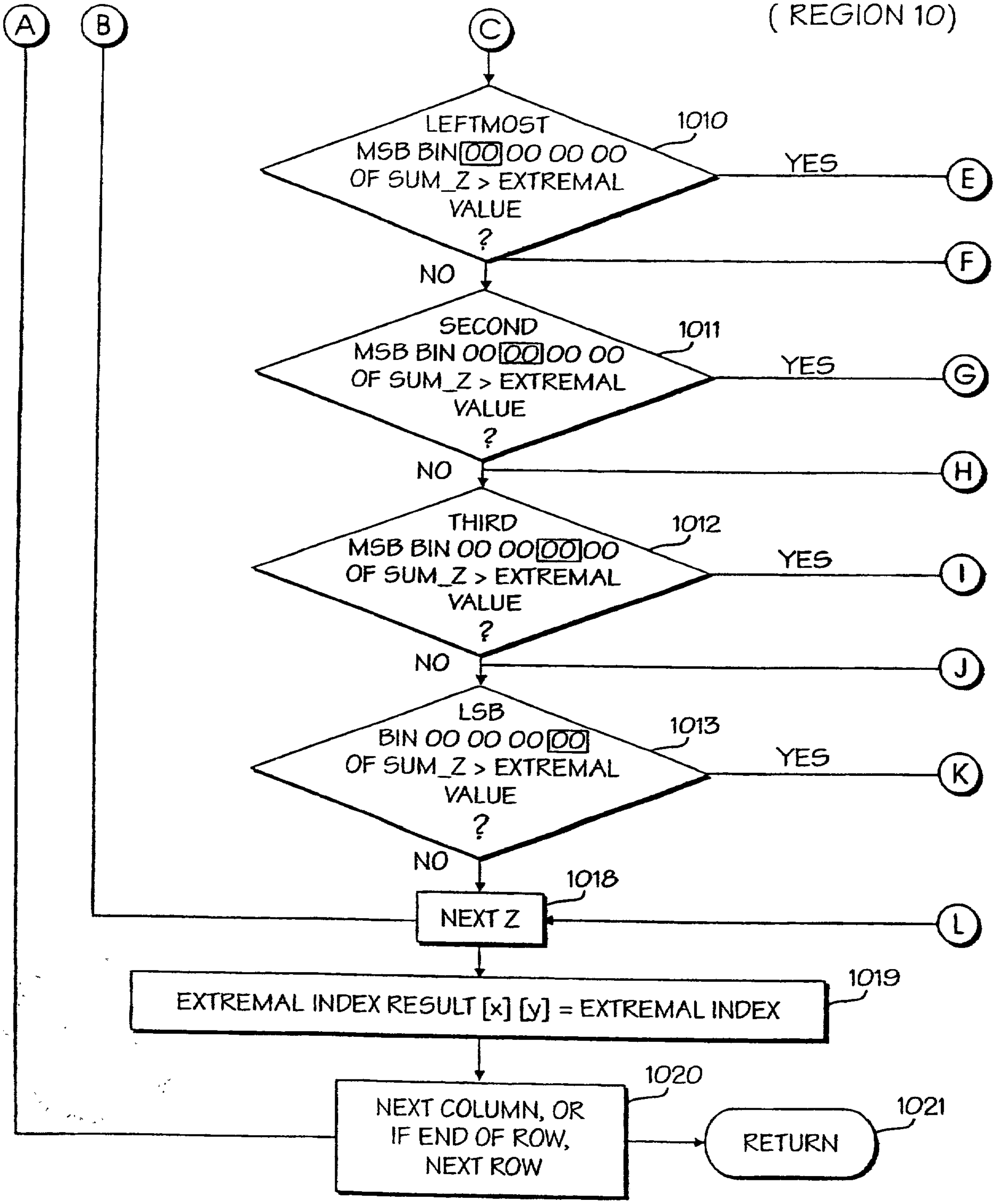


FIG. 45(C)

MODE FILTER
(REGION 10)

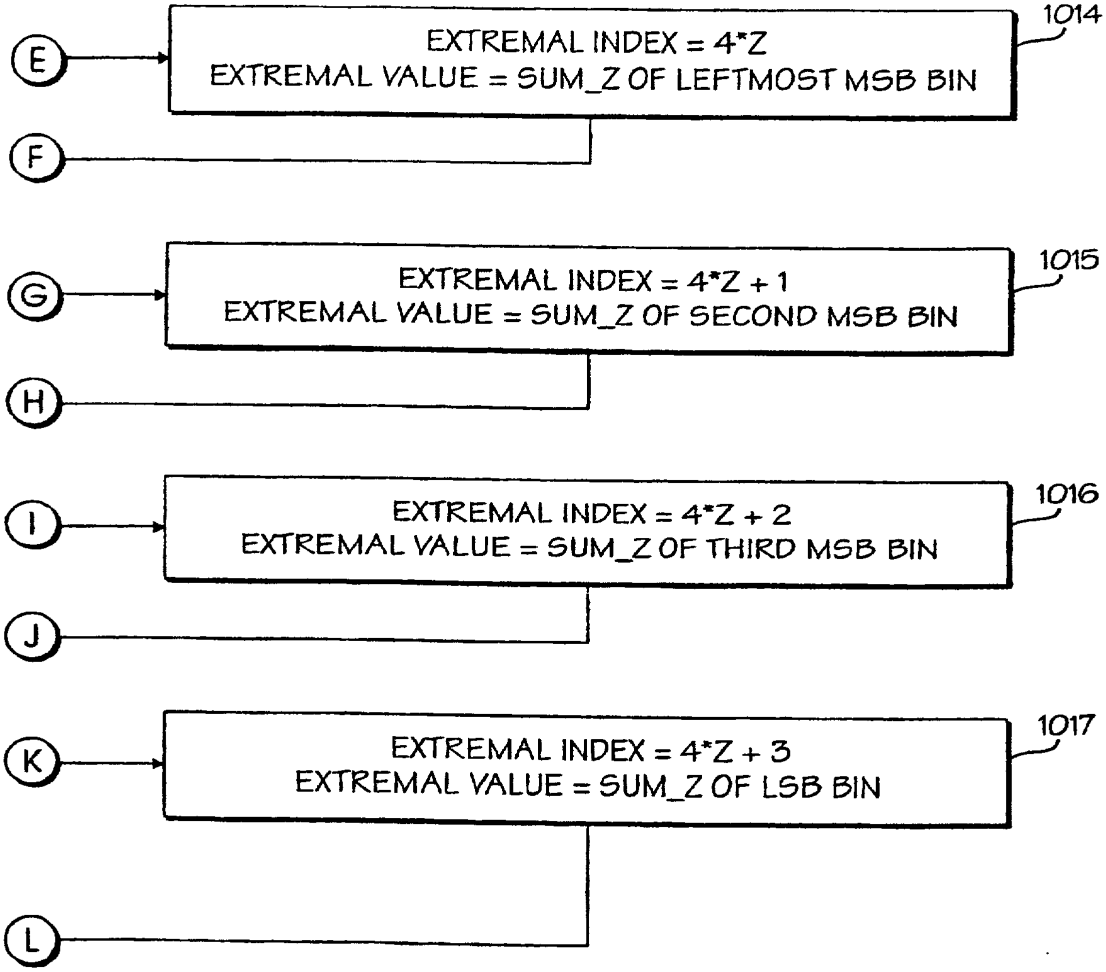


FIG. 45(D)

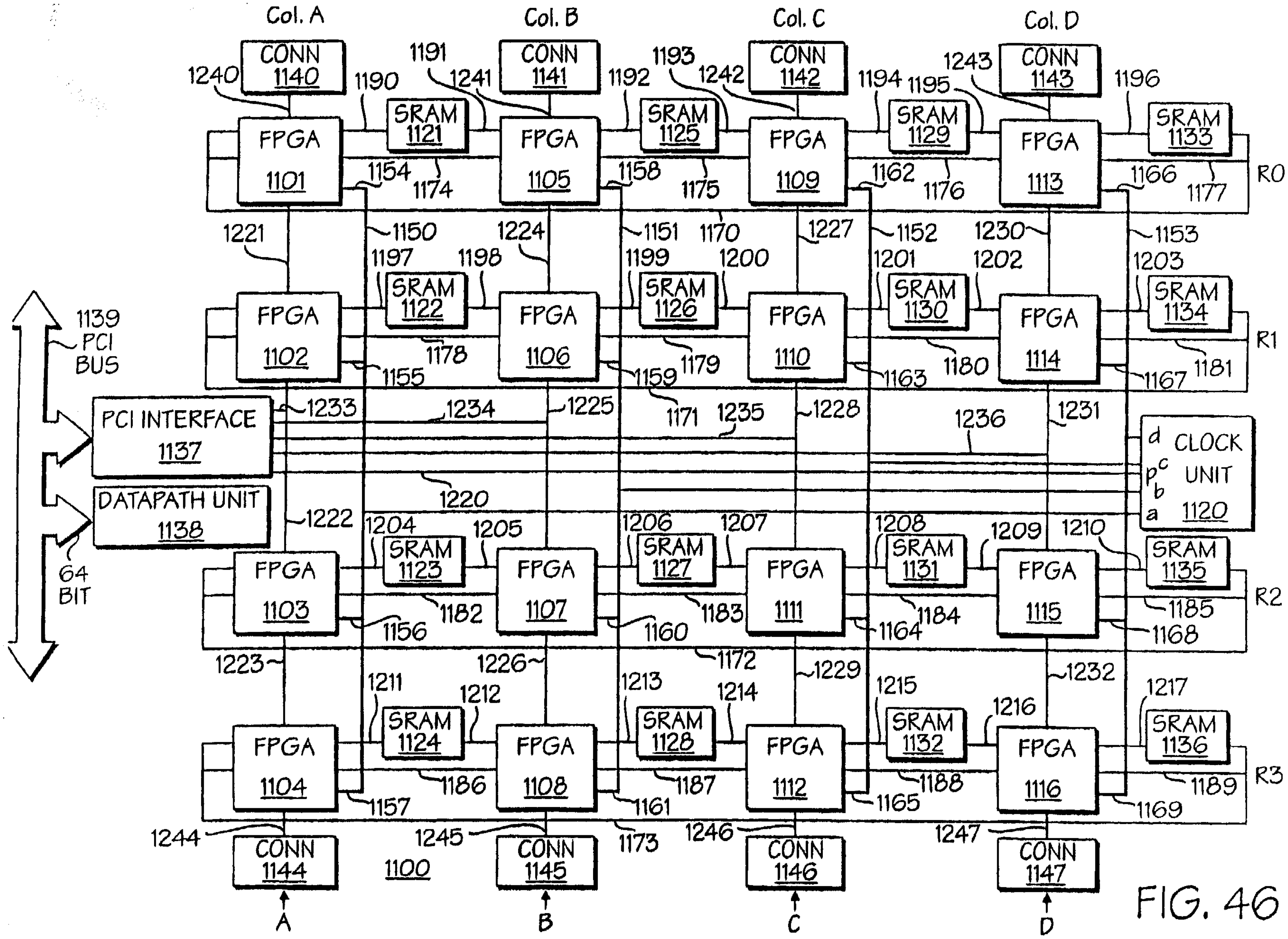

Col. A
Col. B
Col. C
Col. D
CONN 1140
CONN 1141
CONN 1142
CONN 1143
1240
1190
1191
1241
1192
1193
1242
1194
1195
1243
1196
SRAM 1121
SRAM 1125
SRAM 1129
SRAM 1133
FPGA 1101
FPGA 1105
FPGA 1109
FPGA 1113
1154
1174
1158
1175
1162
1176
1166
1177
R0
1221
1150
1224
1151
1170
1227
1152
1230
1153
1197
1198
1199
1200
1201
1202
1203
SRAM 1122
SRAM 1126
SRAM 1130
SRAM 1134
FPGA 1102
FPGA 1106
FPGA 1110
FPGA 1114
1178
1179
1180
1181
R1
1155
1159
1163
1167
1139
PCI
BUS
PCI INTERFACE 1137
DATAPATH UNIT 1138
64
BIT
1233
1234
1225
1171
1235
1228
1236
1231
d
c
p
b
a
CLOCK UNIT 1120
1220
1222
1204
1205
1206
1207
1208
1209
1210
SRAM 1123
SRAM 1127
SRAM 1131
SRAM 1135
FPGA 1103
FPGA 1107
FPGA 1111
FPGA 1115
1182
1183
1184
1185
R2
1156
1160
1164
1168
1172
1223
1226
1229
1232
1211
1212
1213
1214
1215
1216
1217
SRAM 1124
SRAM 1128
SRAM 1132
SRAM 1136
FPGA 1104
FPGA 1108
FPGA 1112
FPGA 1116
1186
1187
1188
1189
R3
1157
1161
1165
1169
1244
1245
1173
1246
1247
CONN 1144
CONN 1145
CONN 1146
CONN 1147
1100
A
B
C
D

FIG. 46

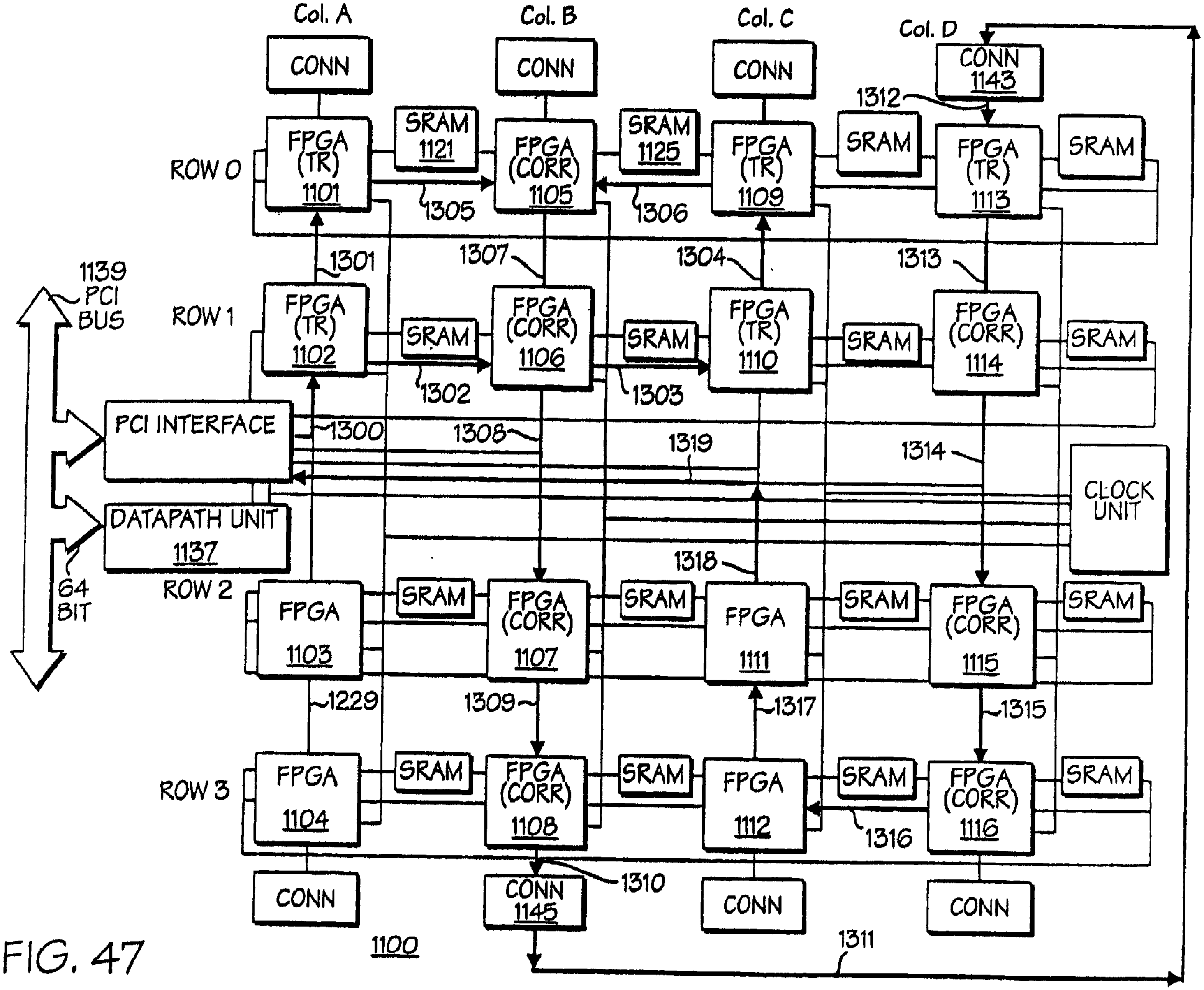

Col. A
Col. B
Col. C
Col. D
CONN
CONN
CONN
CONN 1143
1312
ROW 0
FPGA (TR) 1101
SRAM 1121
FPGA (CORR) 1105
SRAM 1125
FPGA (TR) 1109
SRAM
FPGA (TR) 1113
SRAM
1305
1306
1301
1307
1304
1313
1139 PCI BUS
ROW 1
FPGA (TR) 1102
SRAM
FPGA (CORR) 1106
SRAM
FPGA (TR) 1110
SRAM
FPGA (CORR) 1114
SRAM
1302
1303
PCI INTERFACE
1300
1308
1319
1314
CLOCK UNIT
DATAPATH UNIT 1137
64 BIT
1318
ROW 2
FPGA 1103
SRAM
FPGA (CORR) 1107
SRAM
FPGA 1111
SRAM
FPGA (CORR) 1115
SRAM
1229
1309
1317
1315
ROW 3
FPGA 1104
SRAM
FPGA (CORR) 1108
SRAM
FPGA 1112
SRAM
FPGA (CORR) 1116
SRAM
1316
CONN
CONN 1145
1310
CONN
CONN
1100
1311

FIG. 47

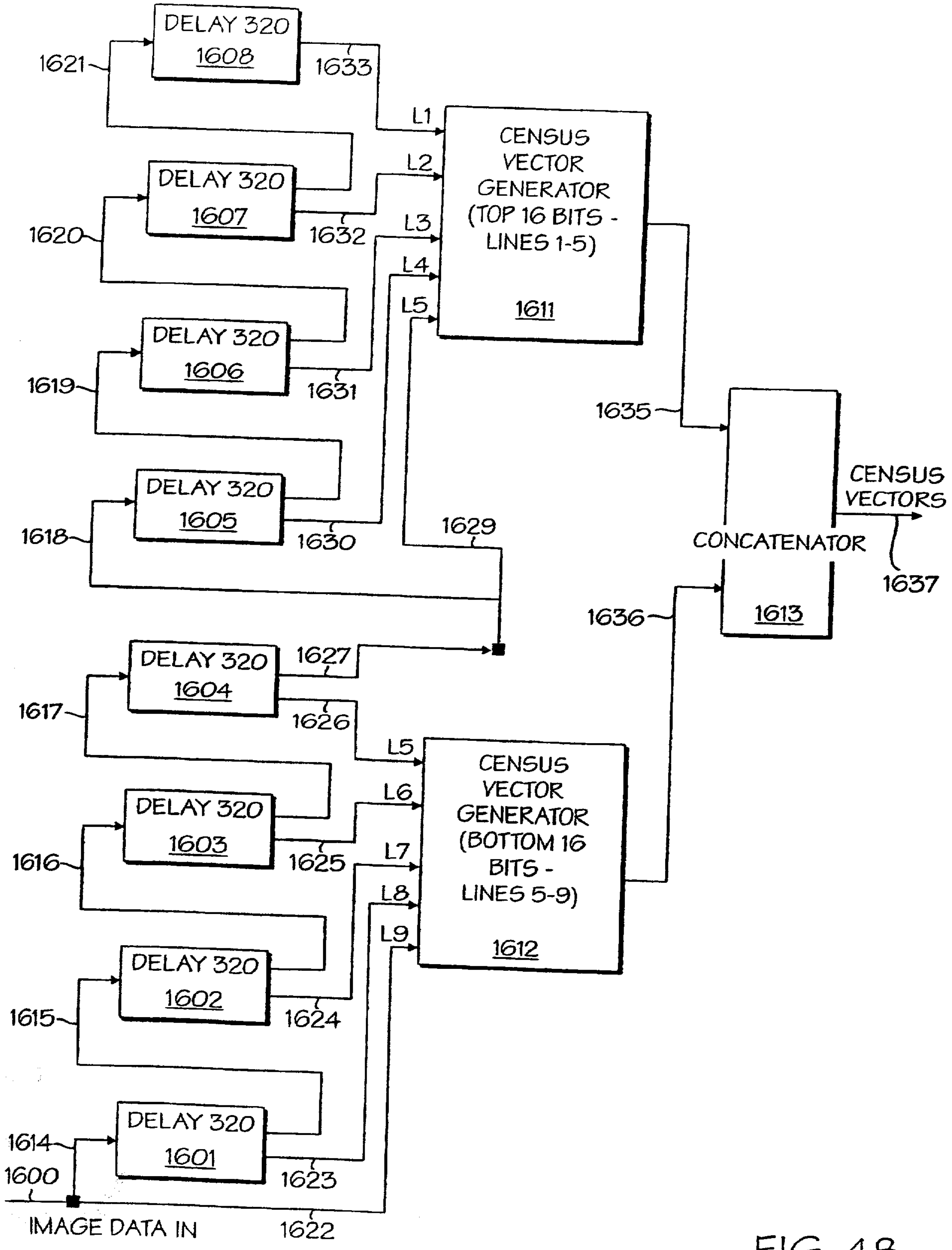

DELAY 320
1608
1621
1633
L1
CENSUS VECTOR GENERATOR (TOP 16 BITS - LINES 1-5)
1611
DELAY 320
1607
1620
1632
L2
L3
L4
L5
DELAY 320
1606
1619
1631
DELAY 320
1605
1618
1630
1629
1635
CONCATENATOR
1613
CENSUS VECTORS
1637
1636
DELAY 320
1604
1617
1627
1626
L5
CENSUS VECTOR GENERATOR (BOTTOM 16 BITS - LINES 5-9)
1612
DELAY 320
1603
1616
1625
L6
L7
L8
L9
DELAY 320
1602
1615
1624
DELAY 320
1601
1614
1623
1600
IMAGE DATA IN
1622

FIG. 48

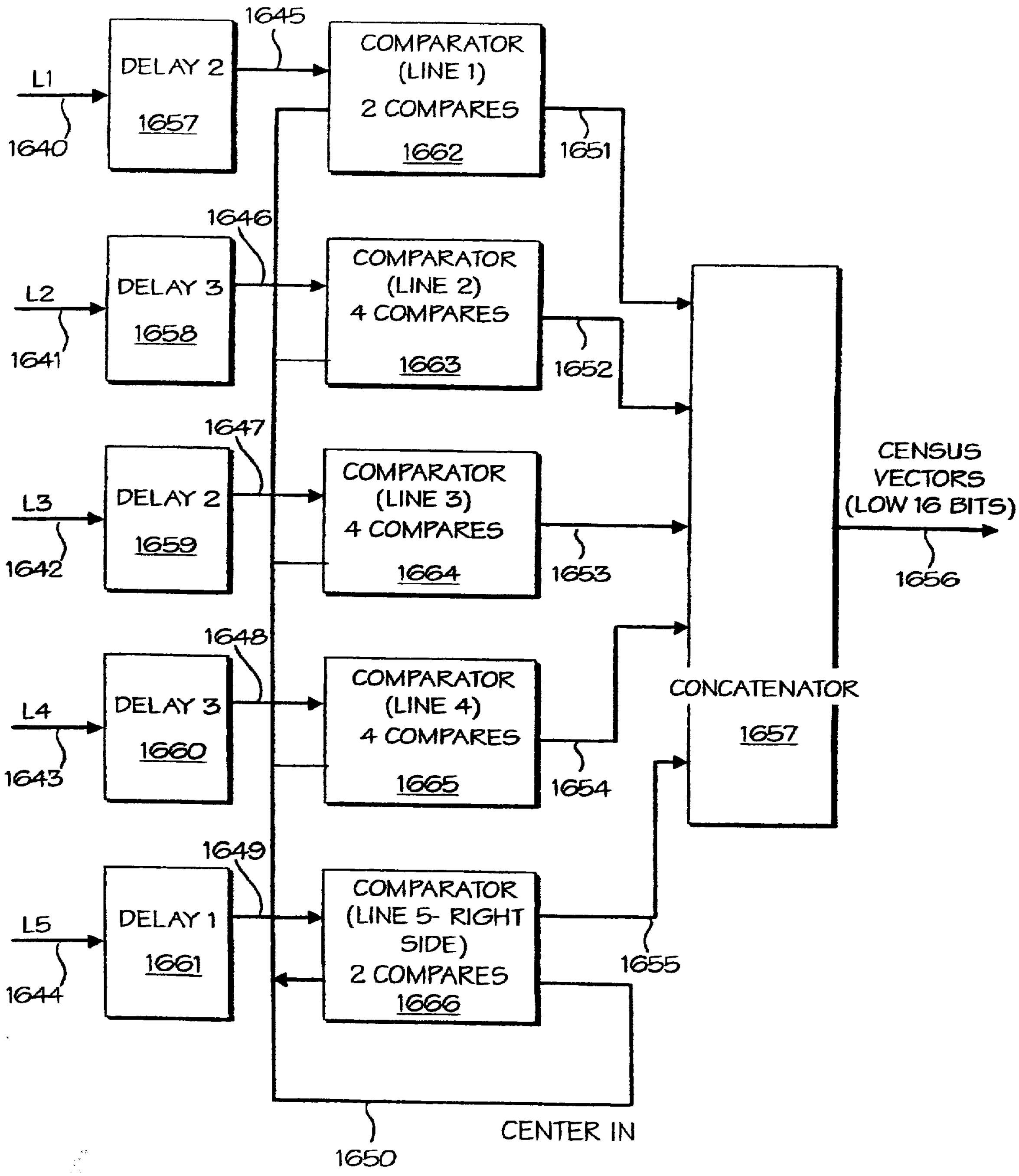

1645
L1
DELAY 2
1657
1640
COMPARATOR (LINE 1) 2 COMPARES
1662
1651
1646
L2
DELAY 3
1658
1641
COMPARATOR (LINE 2) 4 COMPARES
1663
1652
1647
L3
DELAY 2
1659
1642
COMPARATOR (LINE 3) 4 COMPARES
1664
1653
CENSUS VECTORS (LOW 16 BITS)
1656
1648
L4
DELAY 3
1660
1643
COMPARATOR (LINE 4) 4 COMPARES
1665
1654
CONCATENATOR
1657
1649
L5
DELAY 1
1661
1644
COMPARATOR (LINE 5- RIGHT SIDE) 2 COMPARES
1666
1655
CENTER IN
1650

FIG. 49

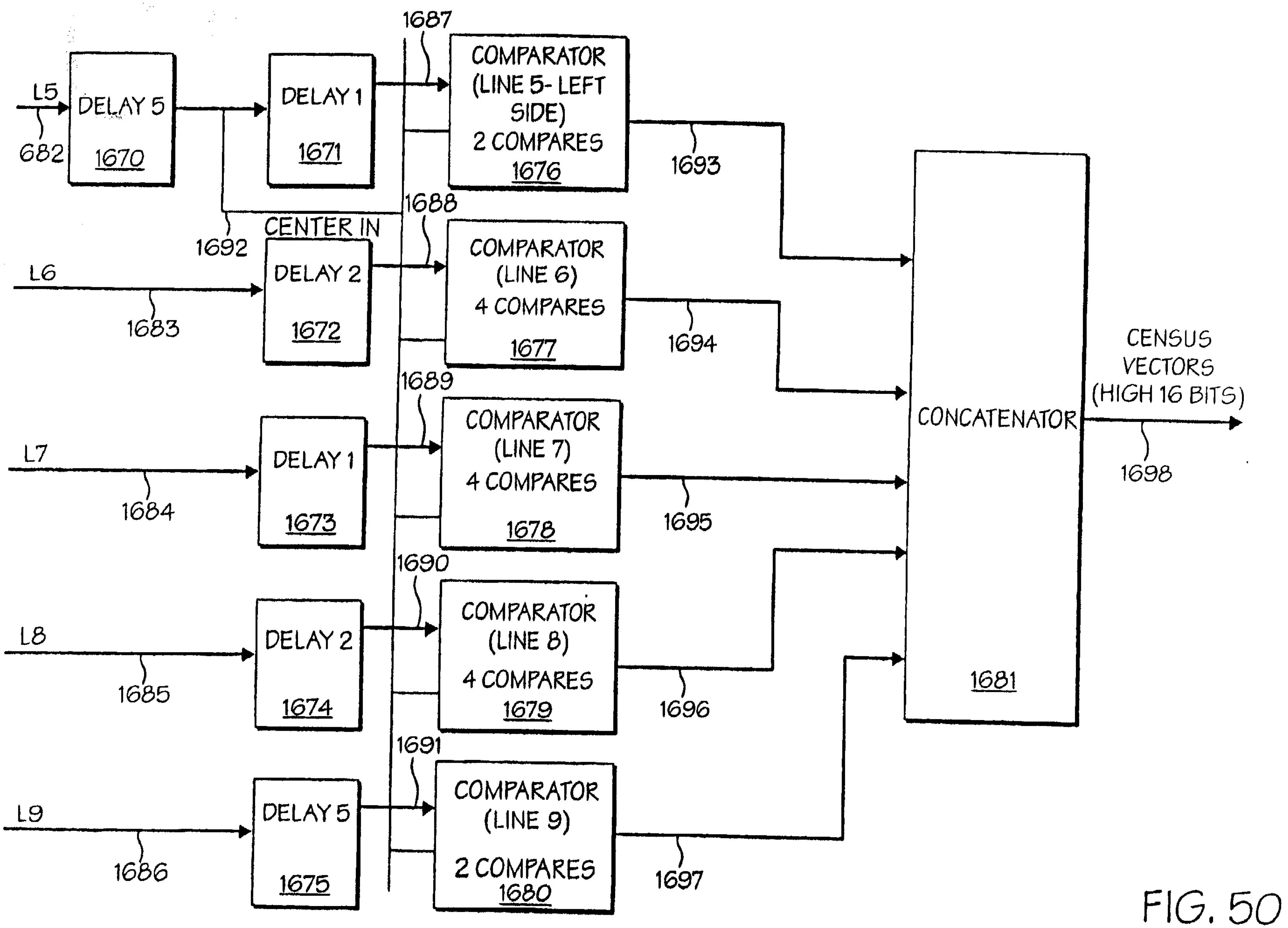

L5
682
DELAY 5
1670
DELAY 1
1671
1692
CENTER IN
L6
1683
DELAY 2
1672
L7
1684
DELAY 1
1673
L8
1685
DELAY 2
1674
L9
1686
DELAY 5
1675
1687
1688
1689
1690
1691
COMPARATOR (LINE 5- LEFT SIDE) 2 COMPARES
1676
COMPARATOR (LINE 6) 4 COMPARES
1677
COMPARATOR (LINE 7) 4 COMPARES
1678
COMPARATOR (LINE 8) 4 COMPARES
1679
COMPARATOR (LINE 9) 2 COMPARES
1680
1693
1694
1695
1696
1697
CONCATENATOR
1681
CENSUS VECTORS (HIGH 16 BITS)
1698

FIG. 50

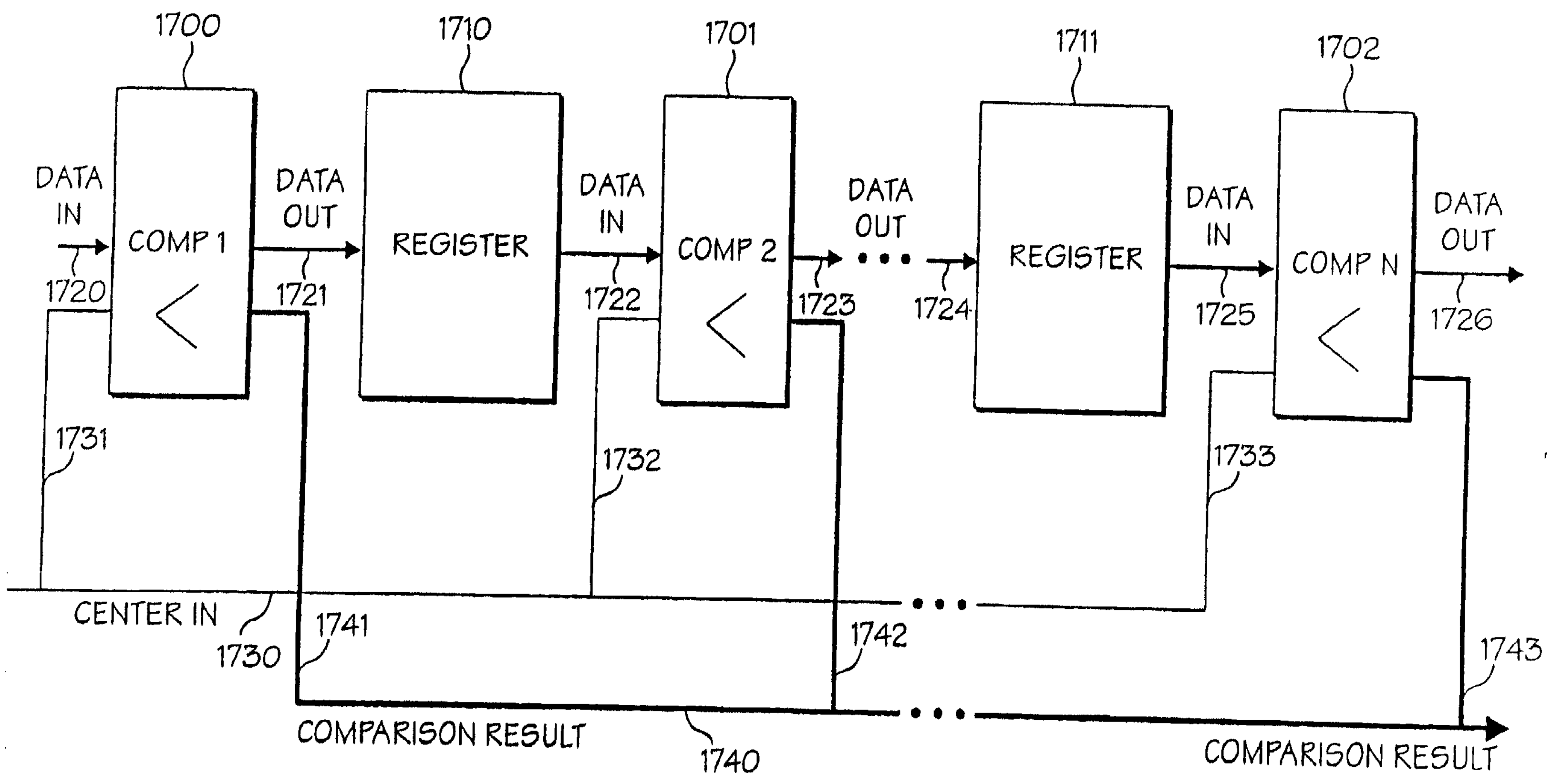

1700
1710
1701
1711
1702
DATA IN
COMP 1
DATA OUT
REGISTER
DATA IN
COMP 2
DATA OUT
REGISTER
DATA IN
COMP N
DATA OUT
1720
1721
1722
1723
1724
1725
1726
1731
1732
1733
CENTER IN
1730
1741
1742
1743
COMPARISON RESULT
1740
COMPARISON RESULT

FIG. 51

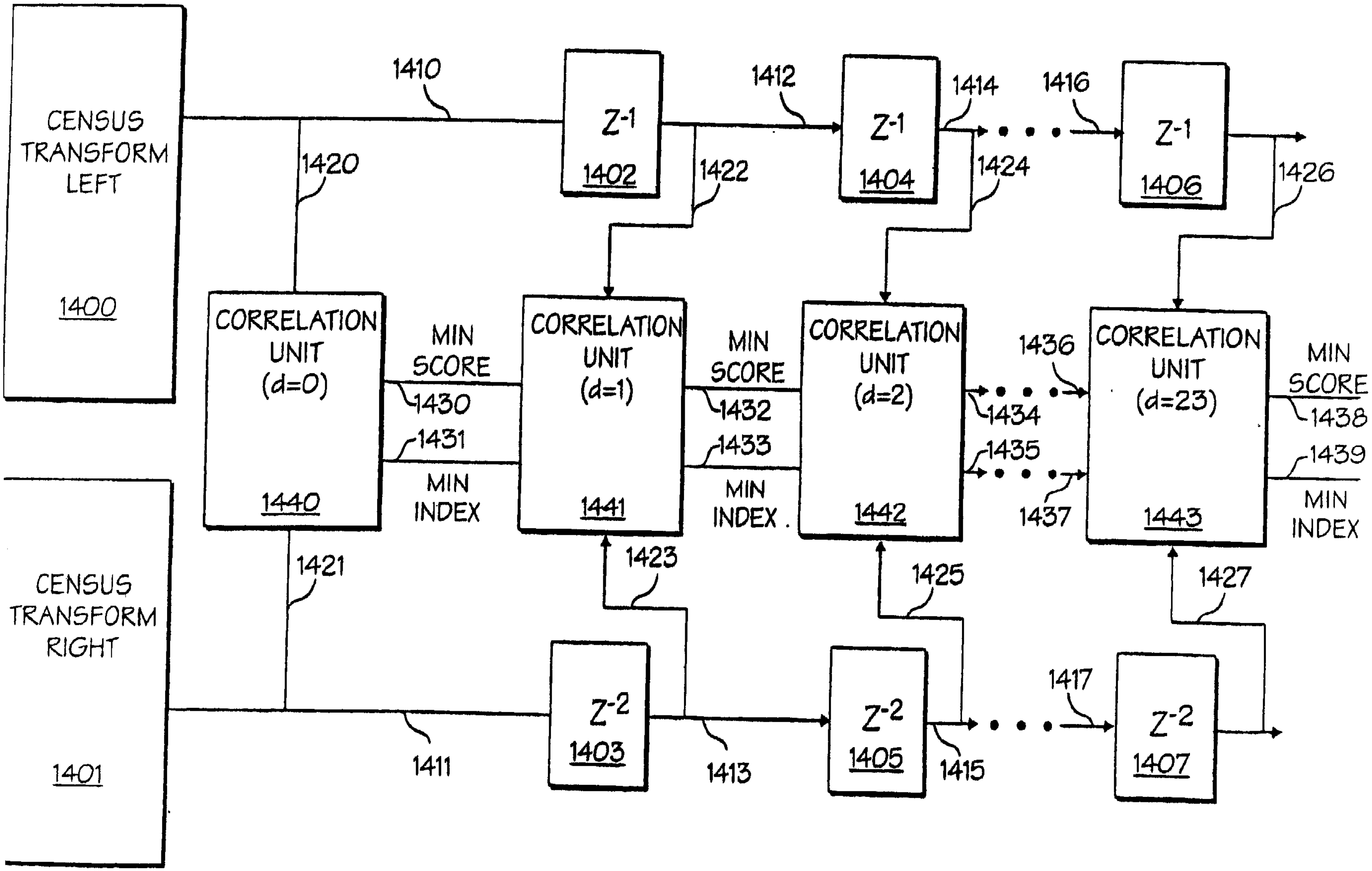

CENSUS TRANSFORM LEFT
1400
CENSUS TRANSFORM RIGHT
1401
1410
1411
1412
1413
1414
1415
1416
1417
Z-1
1402
Z-1
1404
Z-1
1406
Z-2
1403
Z-2
1405
Z-2
1407
1420
1421
1422
1423
1424
1425
1426
1427
CORRELATION UNIT (d=0)
1440
CORRELATION UNIT (d=1)
1441
CORRELATION UNIT (d=2)
1442
CORRELATION UNIT (d=23)
1443
MIN SCORE
1430
1431
MIN INDEX
MIN SCORE
1432
1433
MIN INDEX
1434
1435
1436
1437
MIN SCORE
1438
1439
MIN INDEX

Fig. 52

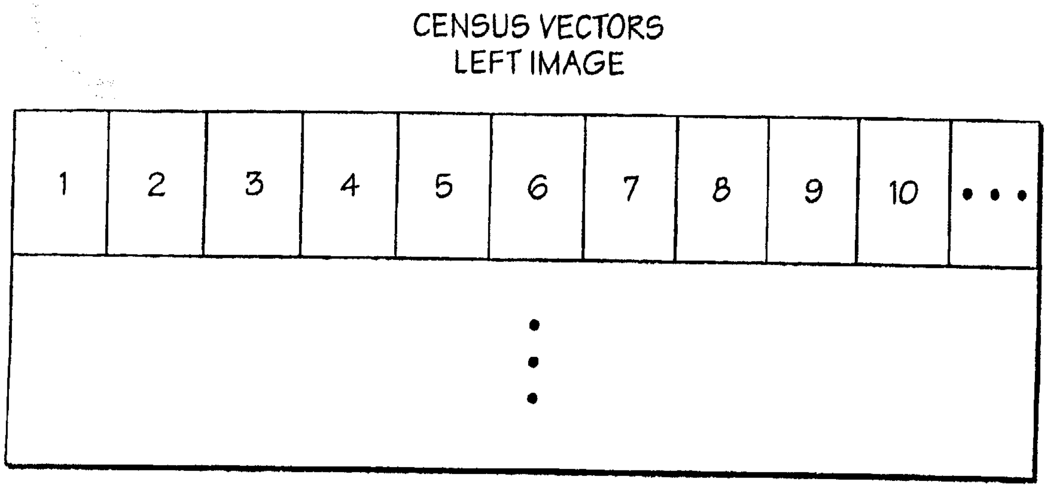


Fig. 53(A)

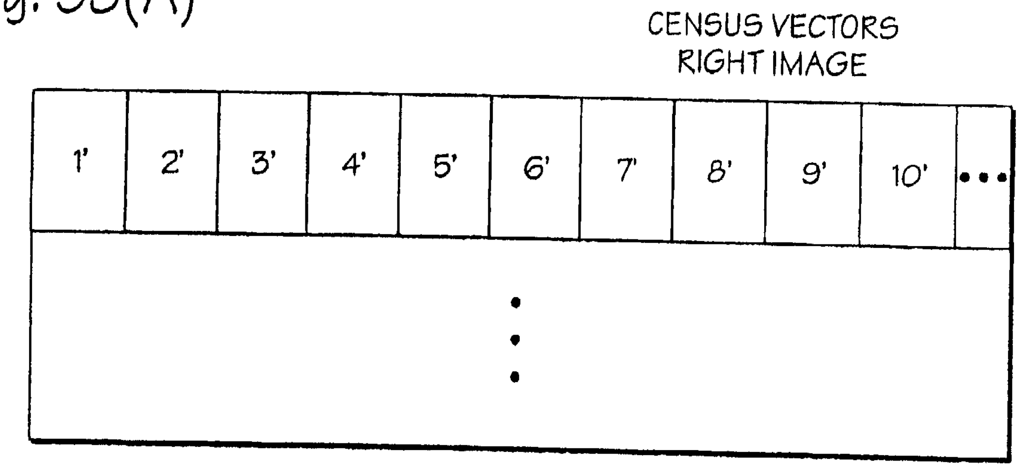


Fig. 53(B)

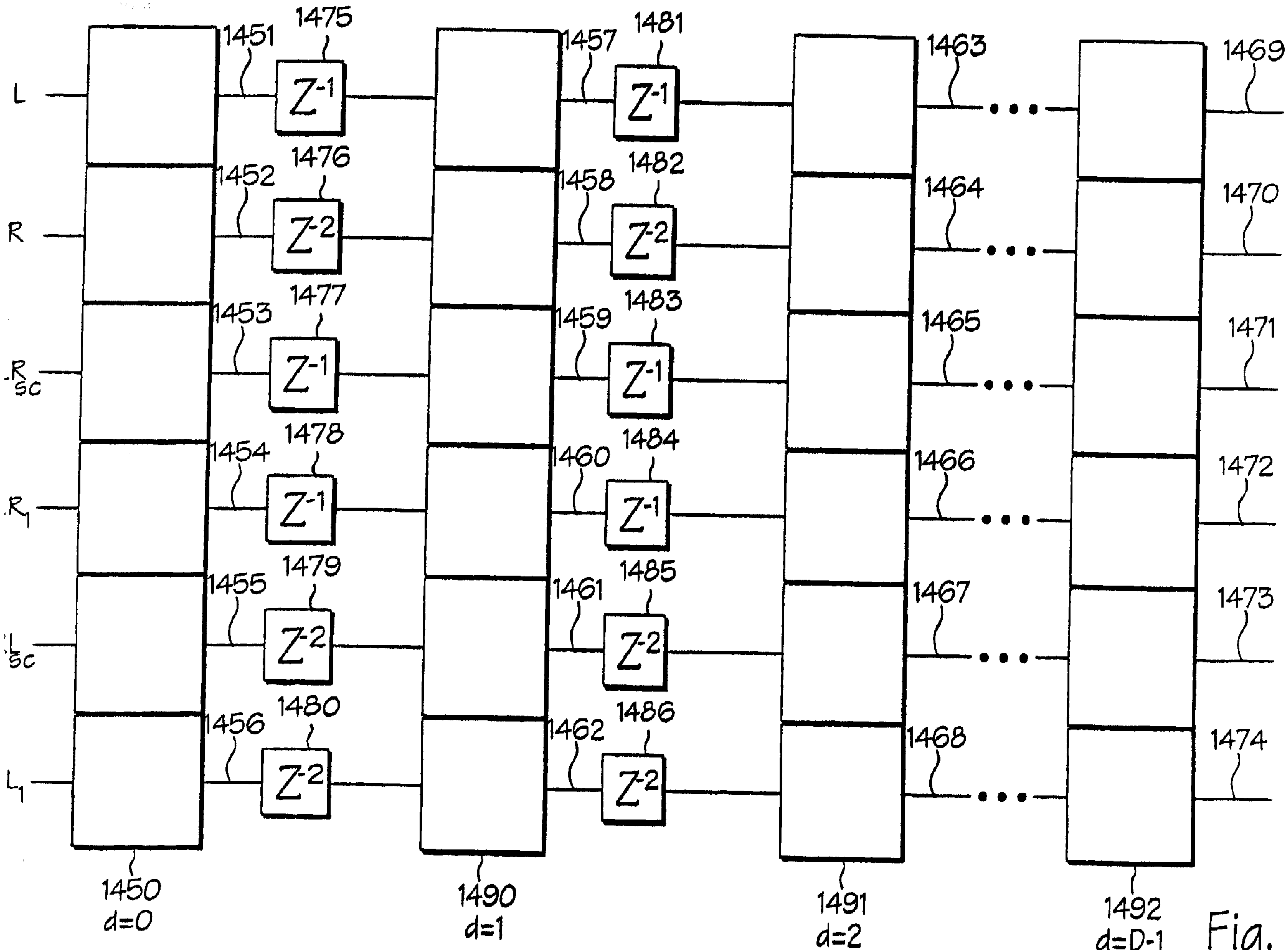

L
R
R_{sc}
R_1
L_{sc}
L_1
1450
d=0
1451
1452
1453
1454
1455
1456
1475
1476
1477
1478
1479
1480
Z^{-1}
Z^{-2}
Z^{-1}
Z^{-1}
Z^{-2}
Z^{-2}
1490
d=1
1457
1458
1459
1460
1461
1462
1481
1482
1483
1484
1485
1486
Z^{-1}
Z^{-2}
Z^{-1}
Z^{-1}
Z^{-2}
Z^{-2}
1491
d=2
1463
1464
1465
1466
1467
1468
1492
d=D-1
1469
1470
1471
1472
1473
1474

Fig. 54

15 IMAGE ELEMENTS (1 TO 15 FOR L; 1' TO 15' FOR R)
D=5 (d= {0, 1, 2, 3, 4})

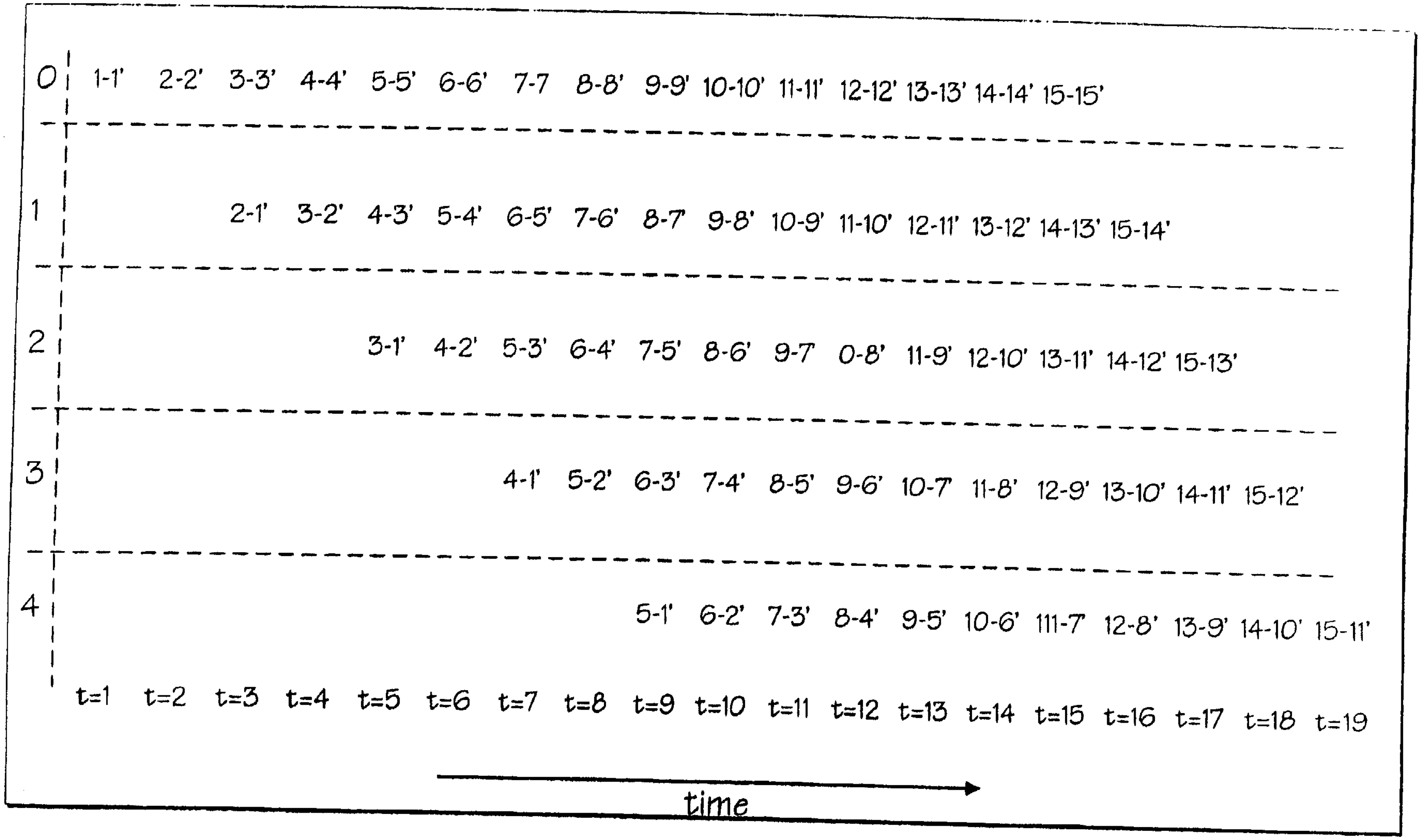


FIG. 55

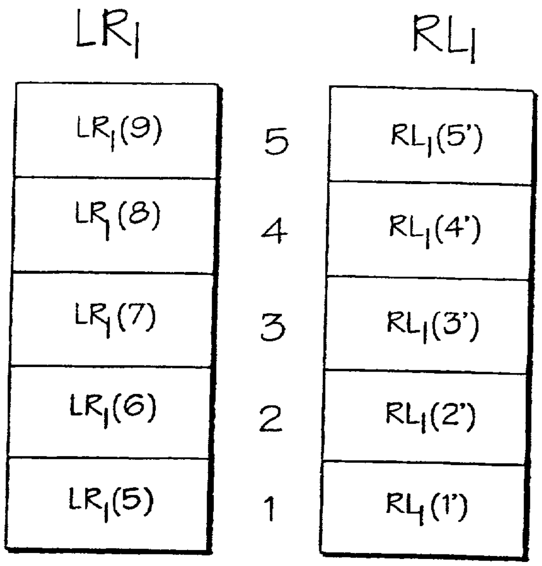


Fig. 56(A)

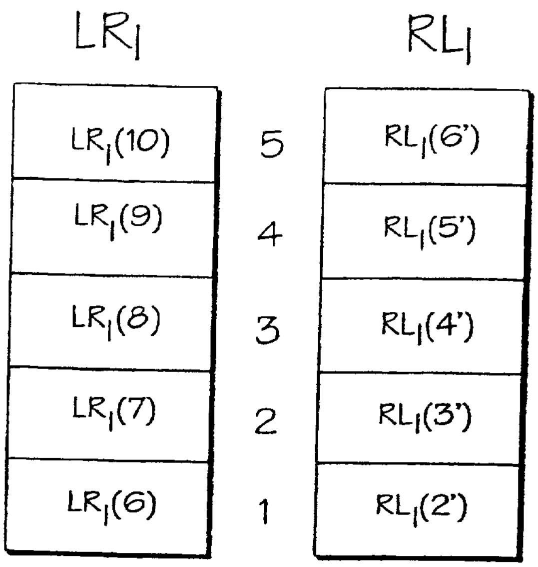


Fig. 56(B)

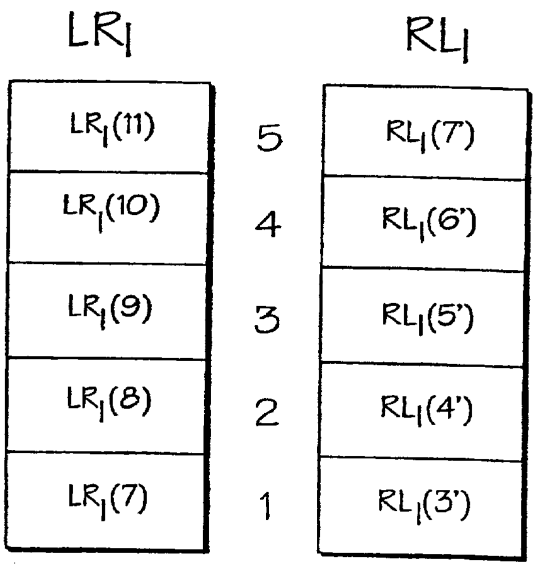


Fig. 56(C)

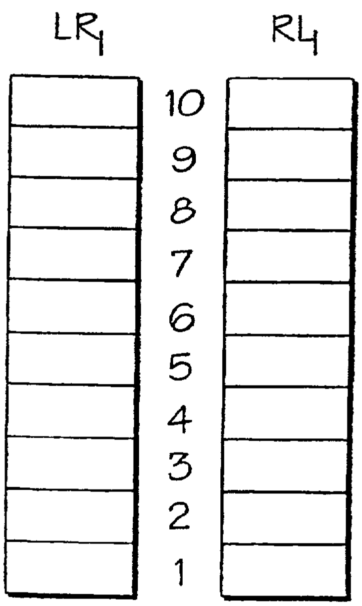


Fig. 56(D)

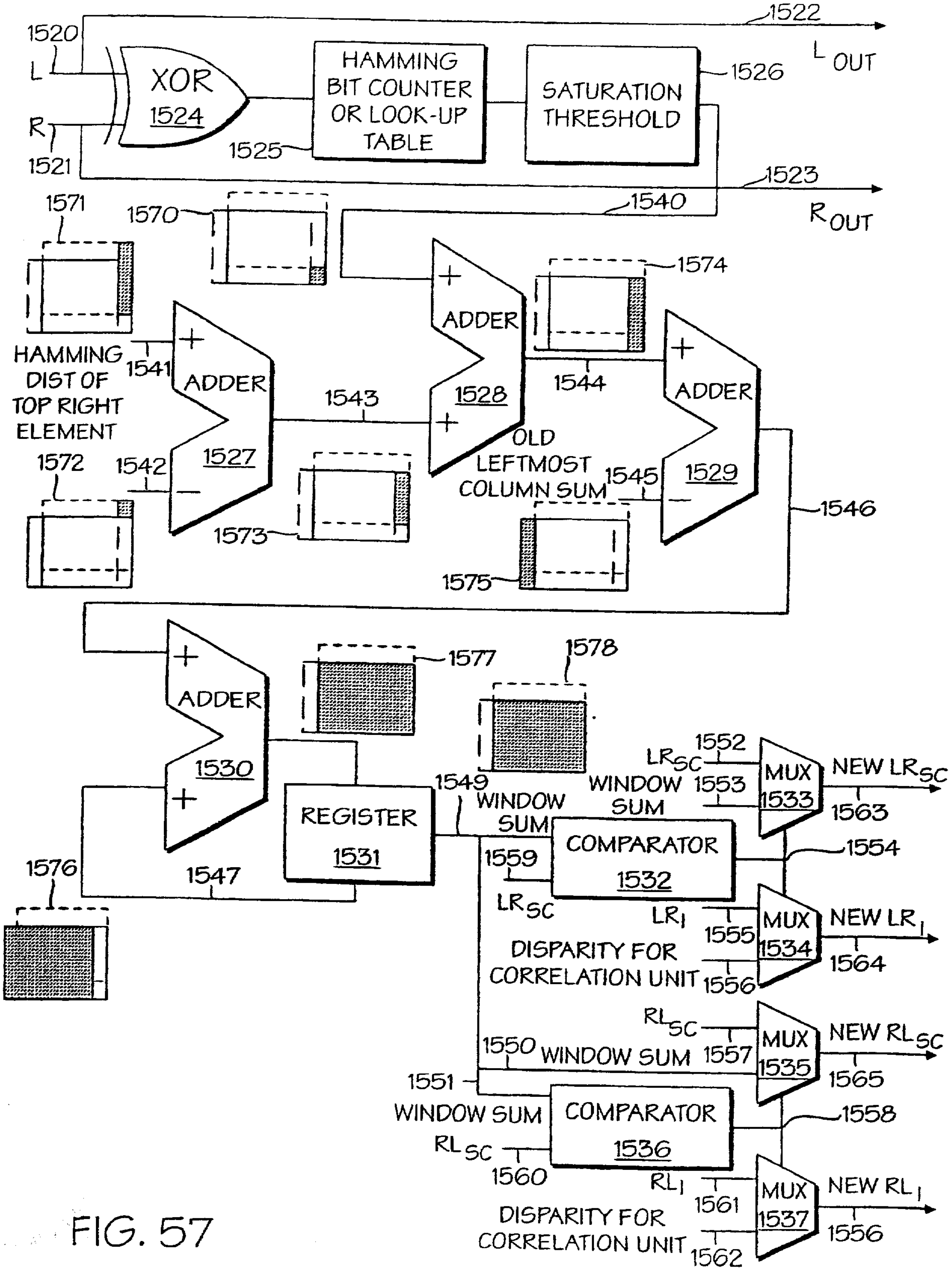

1520
L
R
1521
XOR
1524
1525
HAMMING BIT COUNTER OR LOOK-UP TABLE
SATURATION THRESHOLD
1526
1522
L OUT
1523
R OUT
1540
1571
1570
1574
HAMMING DIST OF TOP RIGHT ELEMENT
1541
+
ADDER
1527
−
1542
1572
1543
1573
+
ADDER
1528
+
1544
OLD LEFTMOST COLUMN SUM
1545
+
ADDER
1529
−
1546
1575
+
ADDER
1530
+
1577
1578
REGISTER
1531
1547
1576
1549
WINDOW SUM
1559
COMPARATOR
1532
LR_{SC}
LR_{SC}
1552
WINDOW SUM
1553
MUX
1533
NEW LR_{SC}
1563
1554
LR_I
1555
MUX
1534
NEW LR_I
1564
DISPARITY FOR CORRELATION UNIT
1556
RL_{SC}
1557
MUX
1535
NEW RL_{SC}
1565
1550
WINDOW SUM
1551
WINDOW SUM
COMPARATOR
1536
1558
RL_{SC}
1560
RL_I
1561
MUX
1537
NEW RL_I
1556
DISPARITY FOR CORRELATION UNIT
1562

FIG. 57

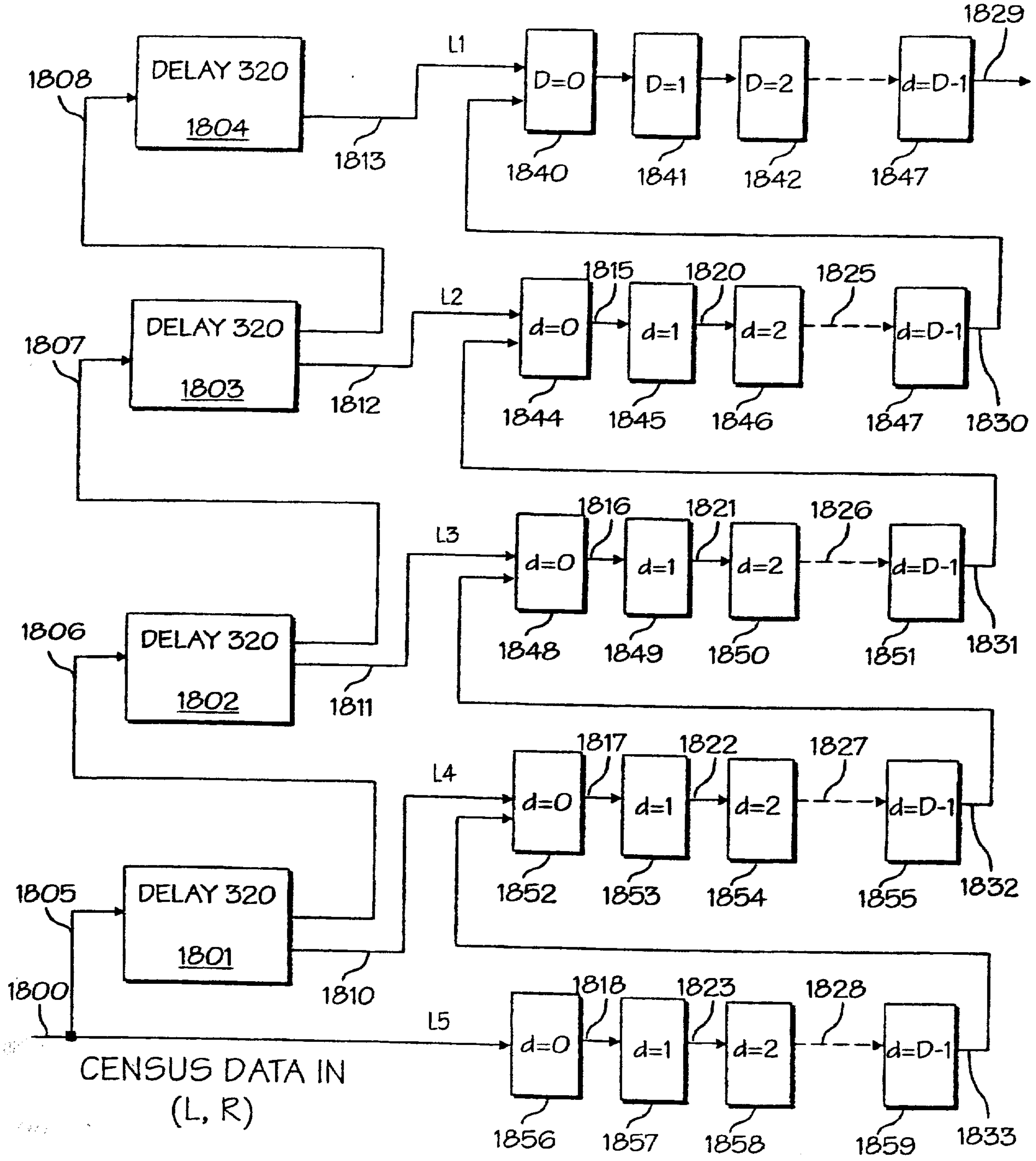

1829
1808
DELAY 320
1804
L1
D=0
D=1
D=2
d=D-1
1813
1840
1841
1842
1847
1815
1820
1825
1807
DELAY 320
1803
L2
d=0
d=1
d=2
d=D-1
1812
1844
1845
1846
1847
1830
1816
1821
1826
L3
d=0
d=1
d=2
d=D-1
1806
DELAY 320
1802
1811
1848
1849
1850
1851
1831
1817
1822
1827
L4
d=0
d=1
d=2
d=D-1
1805
DELAY 320
1801
1810
1852
1853
1854
1855
1832
1800
1818
1823
1828
L5
d=0
d=1
d=2
d=D-1
CENSUS DATA IN
(L, R)
1856
1857
1858
1859
1833

FIG. 58

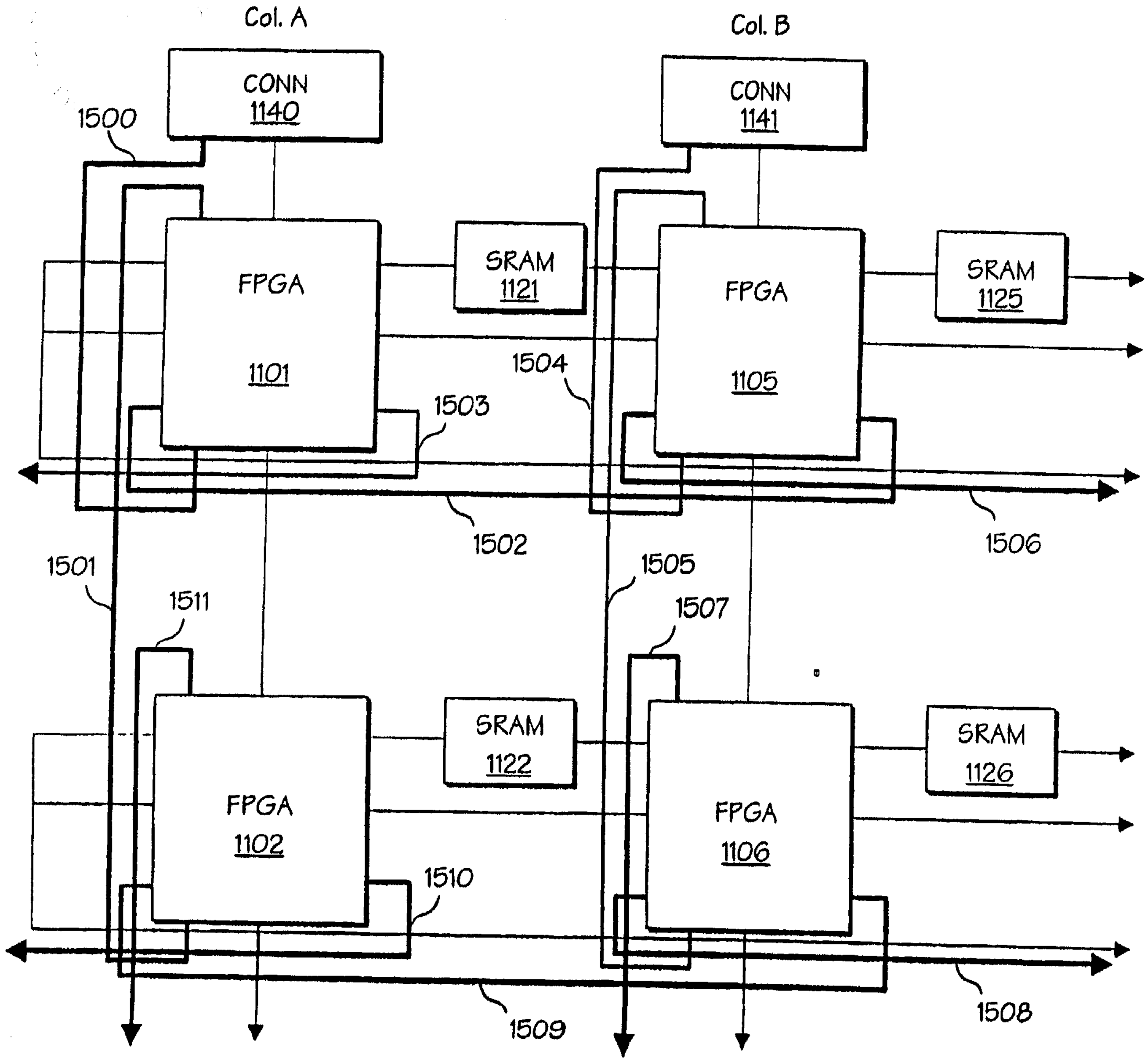

Col. A
Col. B
CONN 1140
CONN 1141
1500
FPGA 1101
SRAM 1121
FPGA 1105
SRAM 1125
1504
1503
1502
1506
1501
1505
1511
1507
FPGA 1102
SRAM 1122
FPGA 1106
SRAM 1126
1510
1509
1508

FIG. 59

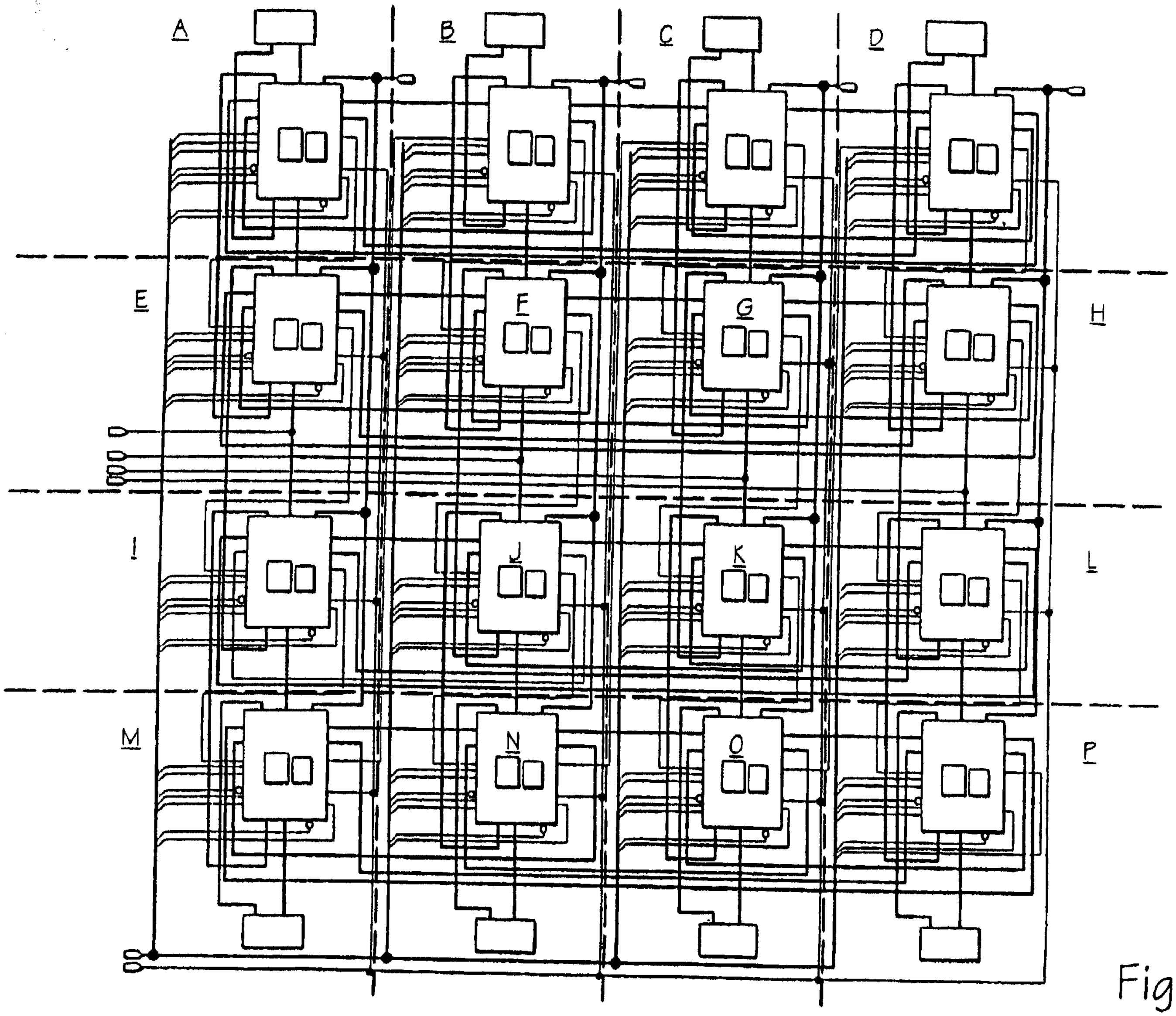


Fig. 60

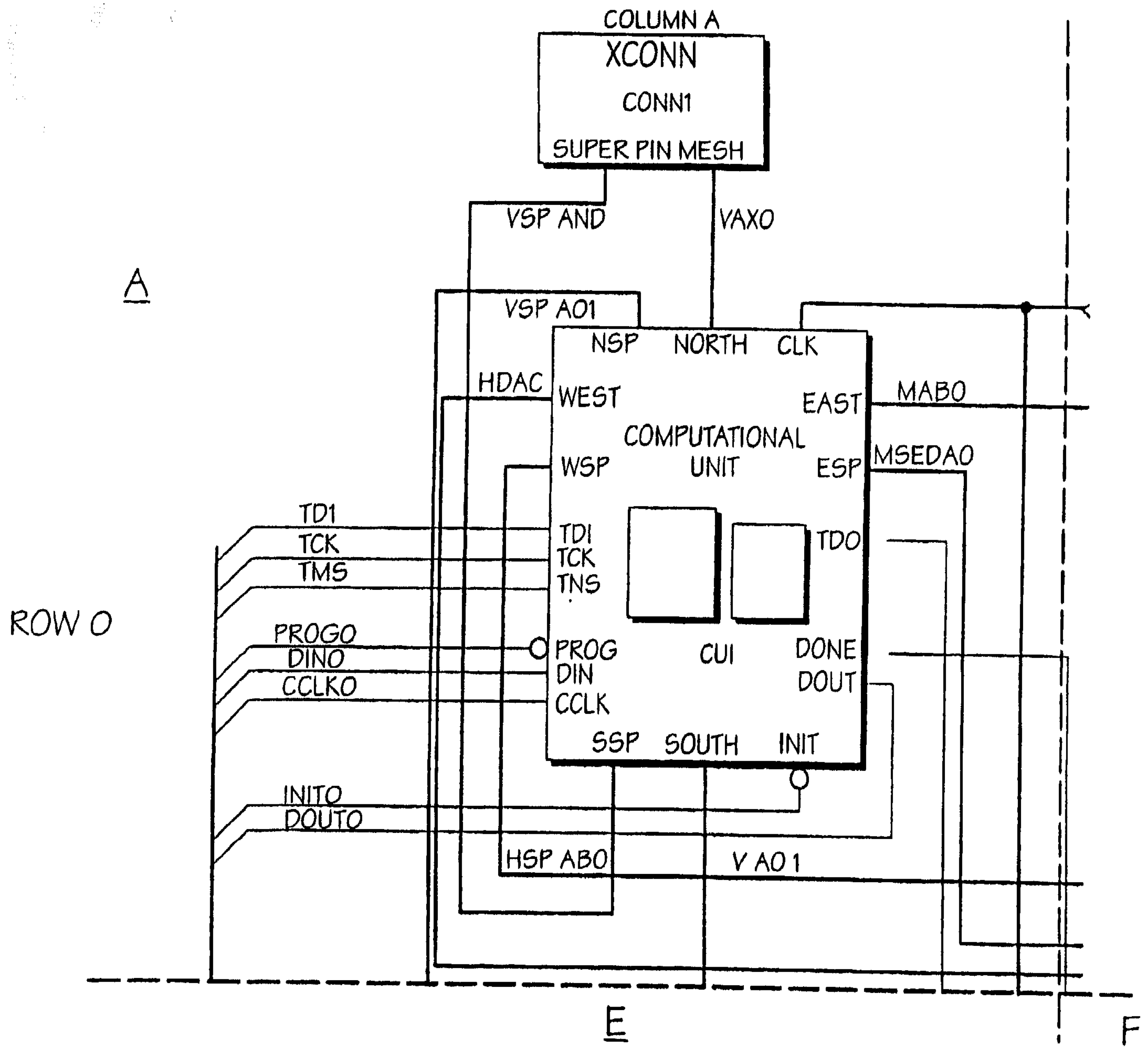

COLUMN A
XCONN
CONN1
SUPER PIN MESH
VSP AND
VAXO
A
B
VSP A01
NSP
NORTH
CLK
HDAC
WEST
EAST
MABO
COMPUTATIONAL
UNIT
WSP
ESP
MSEDAO
TD1
TCK
TMS
TDI
TCK
TNS
TDO
ROW 0
PROGO
DINO
CCLKO
PROG
DIN
CCLK
CUI
DONE
DOUT
SSP
SOUTH
INIT
INITO
DOUTO
HSP ABO
V A0 1
E
E

Fig. 60A

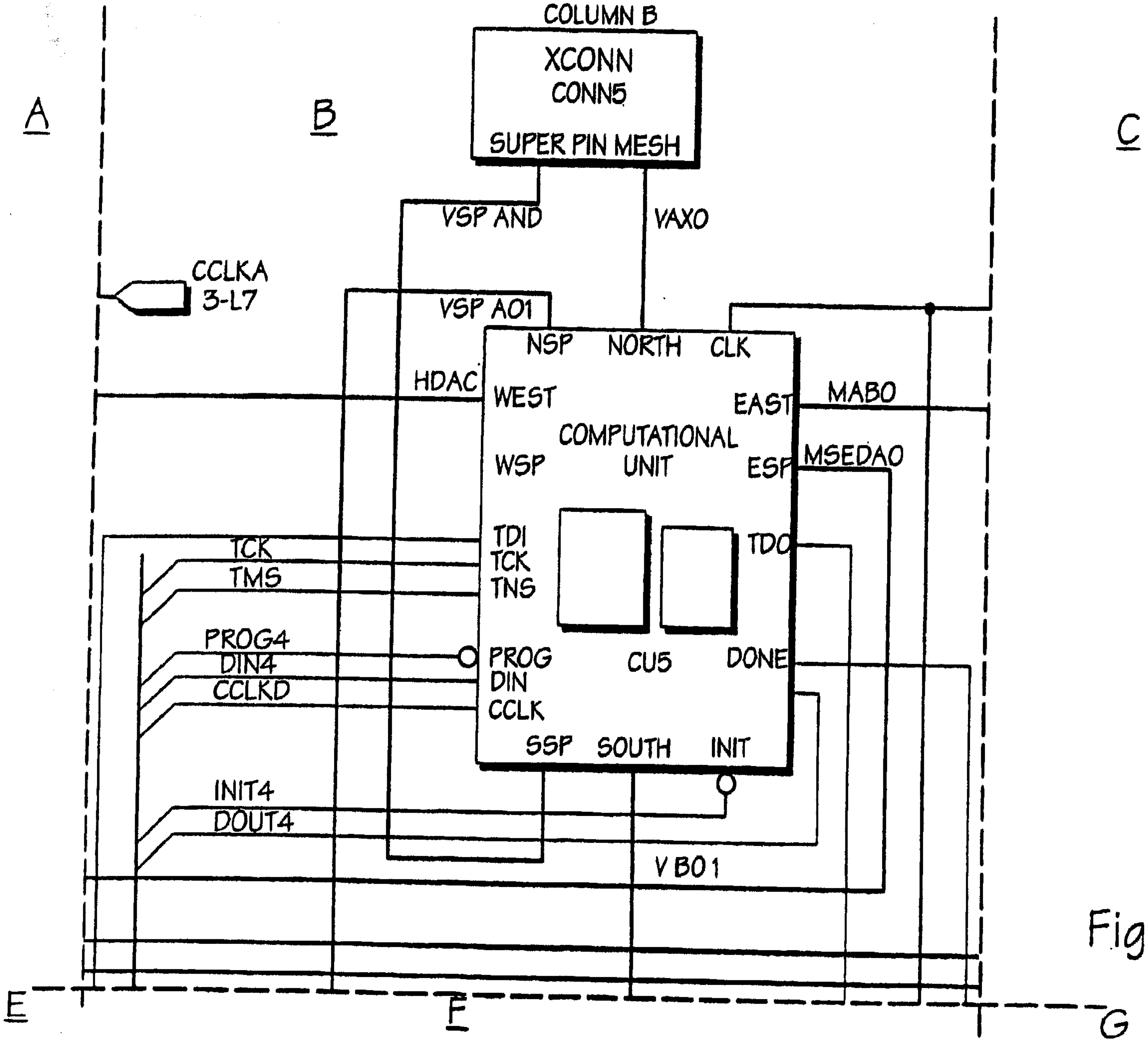

A
B
C
COLUMN B
XCONN
CONN5
SUPER PIN MESH
VSP AND
VAXO
CCLKA
3-L7
VSP A01
NSP
NORTH
CLK
HDAC
WEST
EAST
MABO
COMPUTATIONAL
UNIT
WSP
ESP
MSEDAO
TDI
TCK
TNS
TDO
TCK
TMS
PROG4
DIN4
CCLKD
PROG
DIN
CCLK
CU5
DONE
SSP
SOUTH
INIT
INIT4
DOUT4
V B01
E
F
G

Fig. 60B

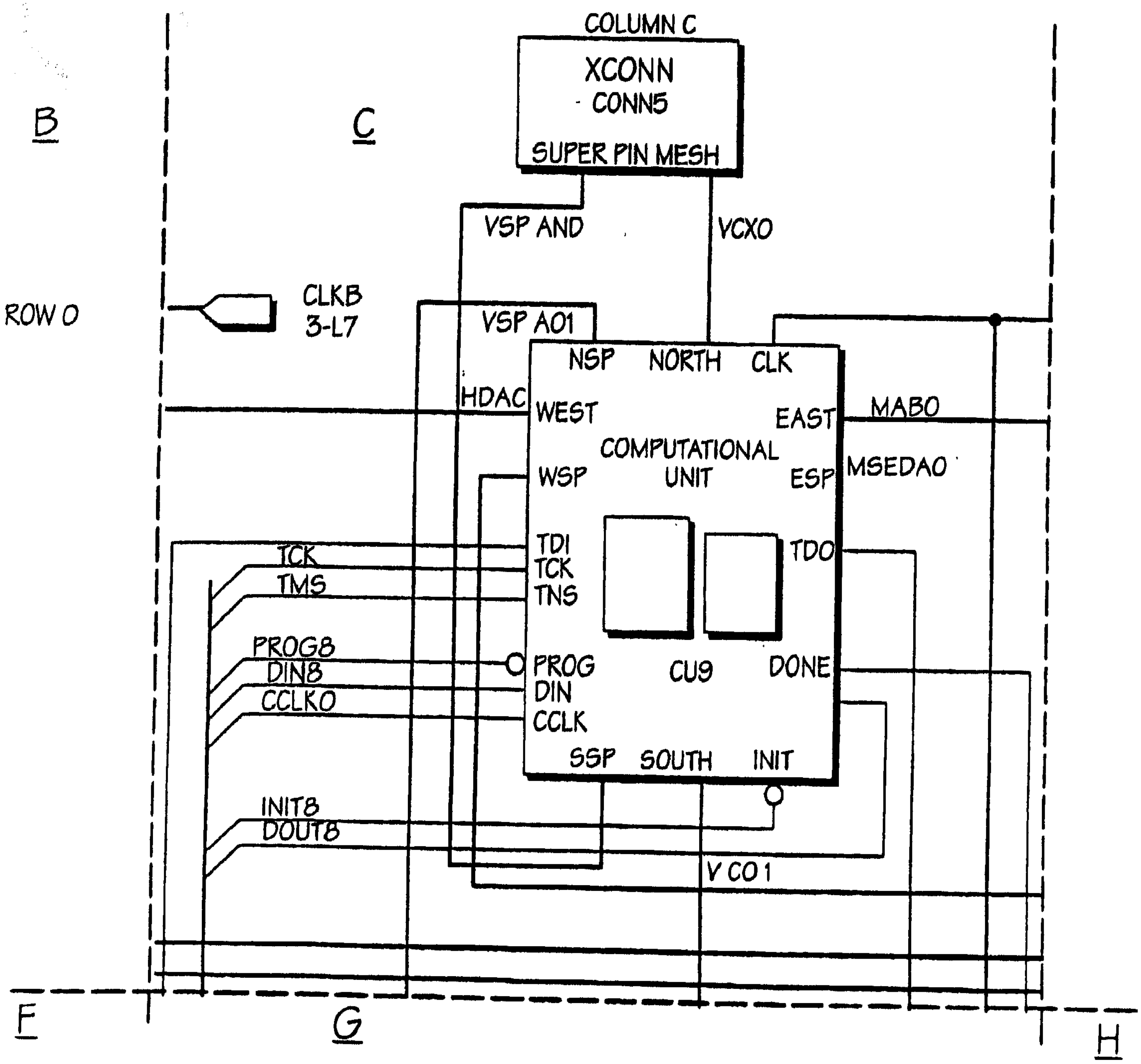

COLUMN C
XCONN
CONN5
SUPER PIN MESH
B
C
D
ROW 0
CLKB
3-L7
VSP AND
VCXO
VSP A01
NSP
NORTH
CLK
HDAC
WEST
EAST
MABO
COMPUTATIONAL
UNIT
WSP
ESP
MSEDAO
TDI
TCK
TNS
TDO
TCK
TMS
PROG8
DIN8
CCLKO
PROG
DIN
CCLK
CU9
DONE
SSP
SOUTH
INIT
INIT8
DOUT8
V CO1
F
G
H

Fig. 60C

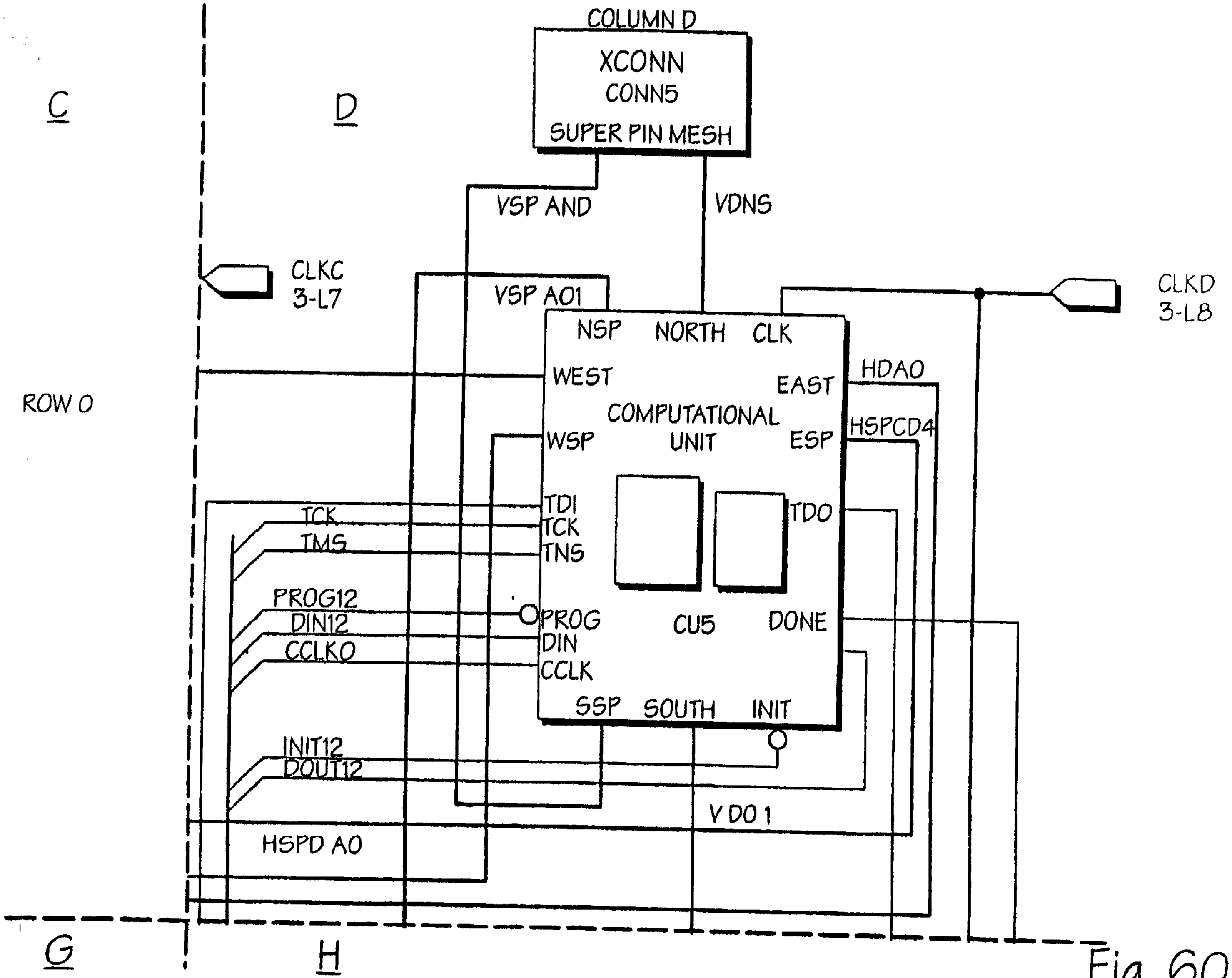

C
D
G
H
ROW 0
COLUMN D
XCONN
CONN5
SUPER PIN MESH
VSP AND
VDNS
CLKC
3-L7
VSP A01
CLKD
3-L8
NSP
NORTH
CLK
WEST
EAST
HDAO
COMPUTATIONAL
UNIT
WSP
ESP
HSPCD4
TDI
TCK
TNS
TDO
TCK
TMS
PROG12
DIN12
CCLKO
PROG
DIN
CCLK
CU5
DONE
SSP
SOUTH
INIT
INIT12
DOUT12
V D0 1
HSPD A0

Fig. 60D

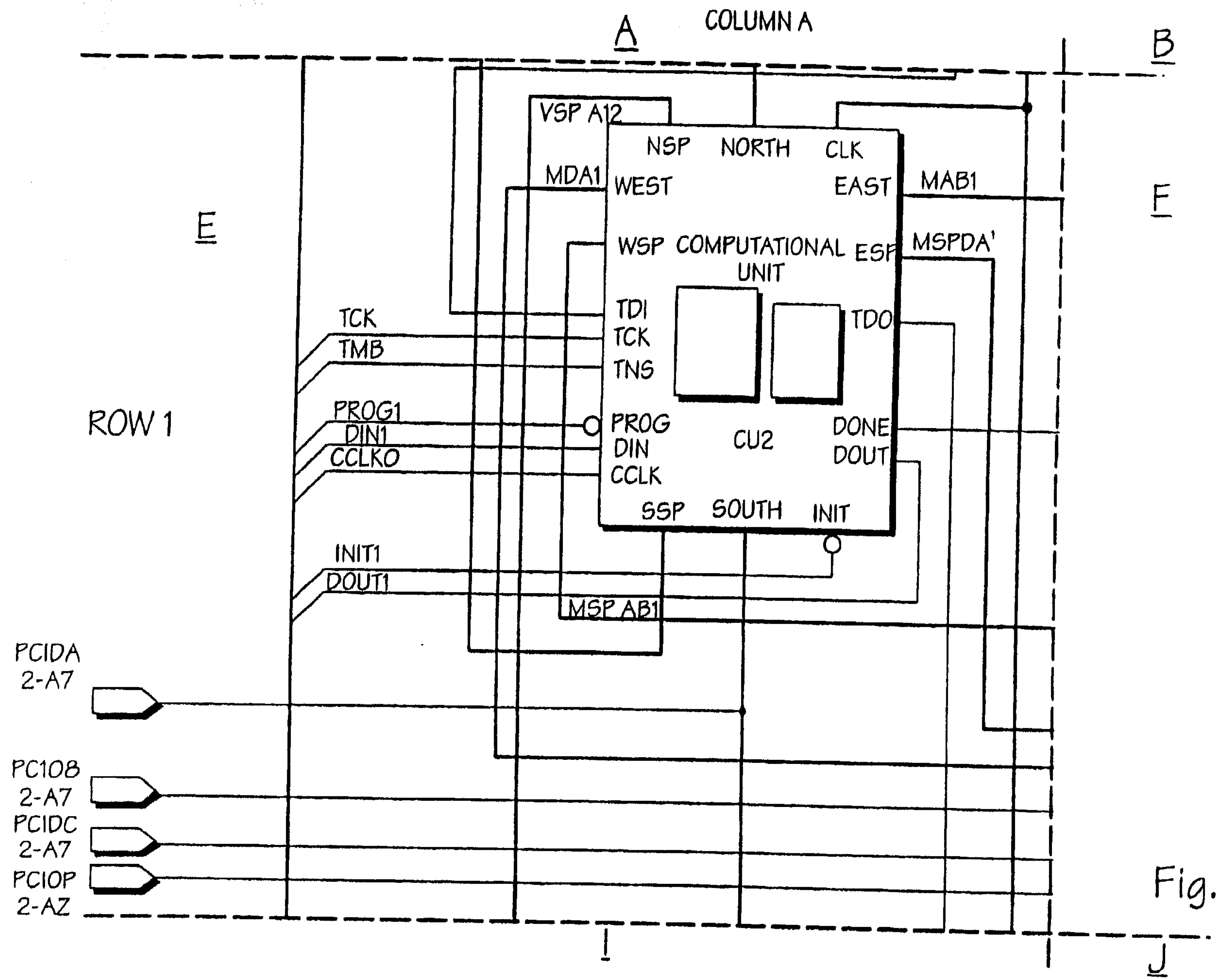

A
COLUMN A
B
E
F
ROW 1
VSP A12
NSP
NORTH
CLK
MDA1
WEST
EAST
MAB1
WSP
COMPUTATIONAL
UNIT
ESP
MSPDA'
TDI
TCK
TNS
TDO
PROG
DIN
CCLK
CU2
DONE
DOUT
SSP
SOUTH
INIT
TCK
TMB
PROG1
DIN1
CCLKO
INIT1
DOUT1
MSP AB1
PCIDA
2-A7
PC108
2-A7
PCIDC
2-A7
PCIOP
2-AZ
I
J

Fig. 60E

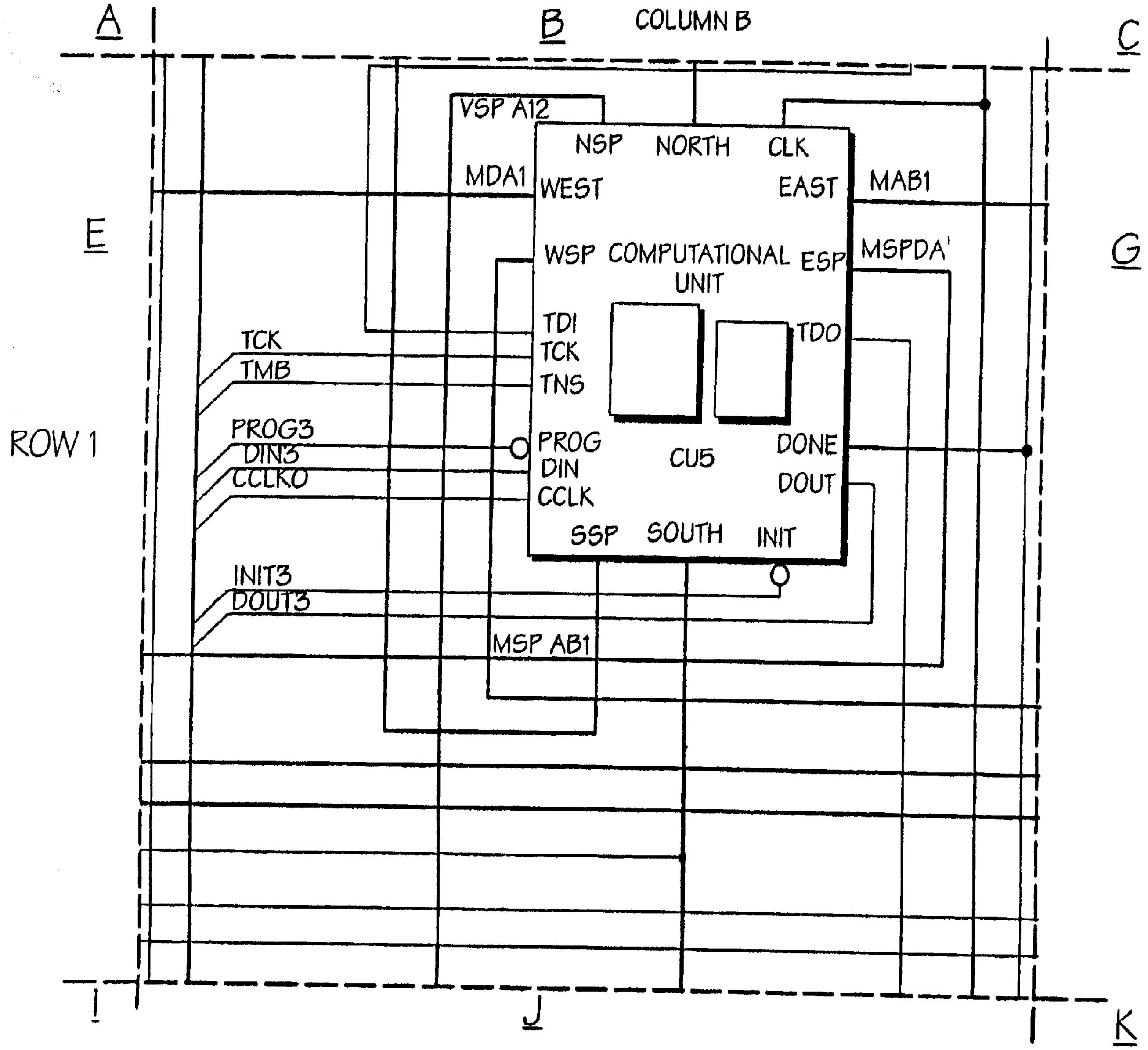

A
B
COLUMN B
C
E
G
ROW 1
VSP A12
NSP
NORTH
CLK
MDA1
WEST
EAST
MAB1
WSP
COMPUTATIONAL UNIT
ESP
MSPDA'
TDI
TCK
TNS
TDO
TCK
TMB
PROG3
DIN3
CCLKO
PROG
DIN
CCLK
CU5
DONE
DOUT
SSP
SOUTH
INIT
INIT3
DOUT3
MSP AB1
I
J
K

Fig. 60F

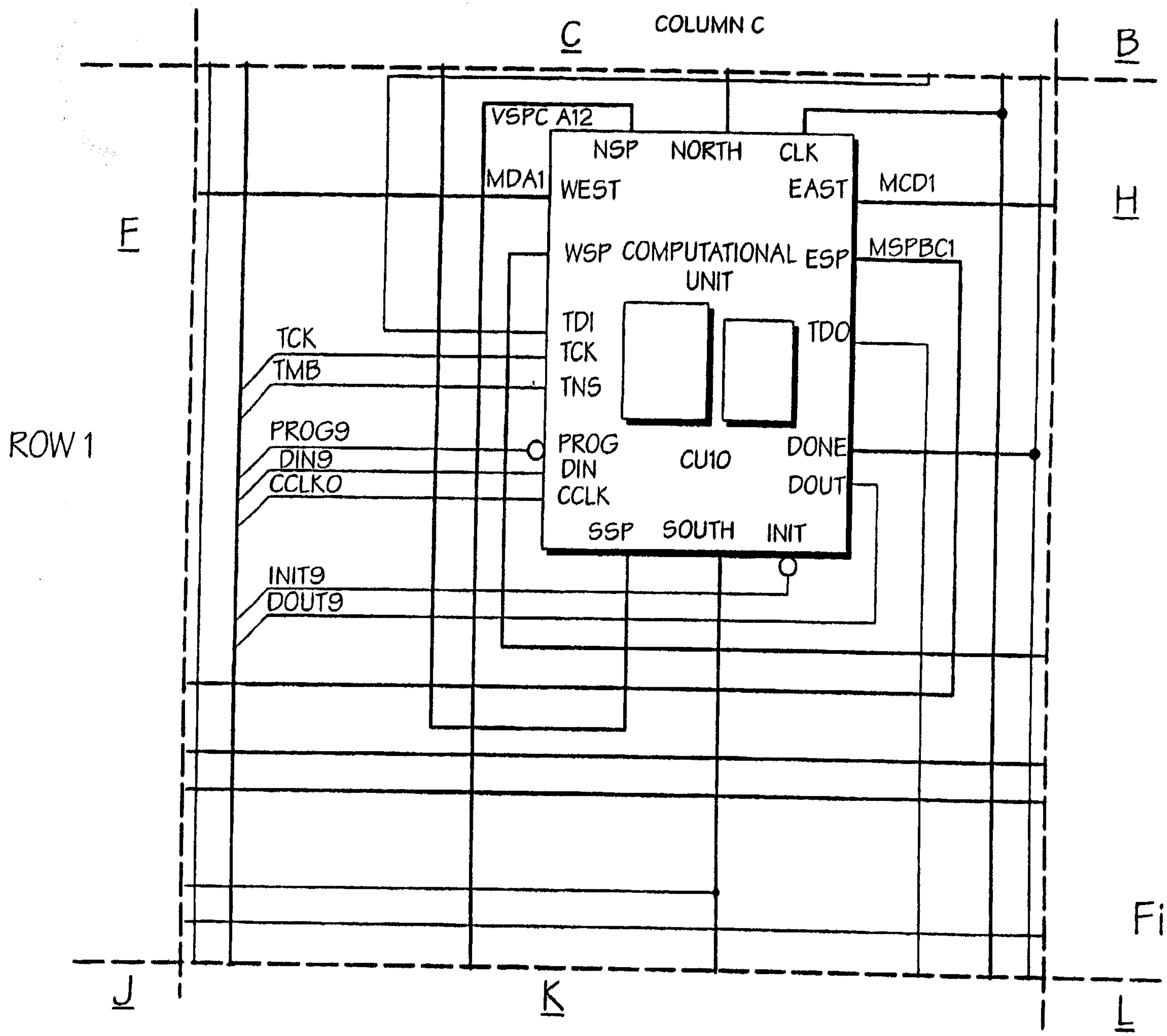

COLUMN C
C
B
VSPC A12
NSP
NORTH
CLK
MDA1
WEST
EAST
MCD1
H
F
WSP
COMPUTATIONAL UNIT
ESP
MSPBC1
TDI
TCK
TNS
TDO
TCK
TMB
ROW 1
PROG9
DIN9
CCLKO
PROG
DIN
CCLK
CU10
DONE
DOUT
SSP
SOUTH
INIT
INIT9
DOUT9
J
K
L

Fig. 60G

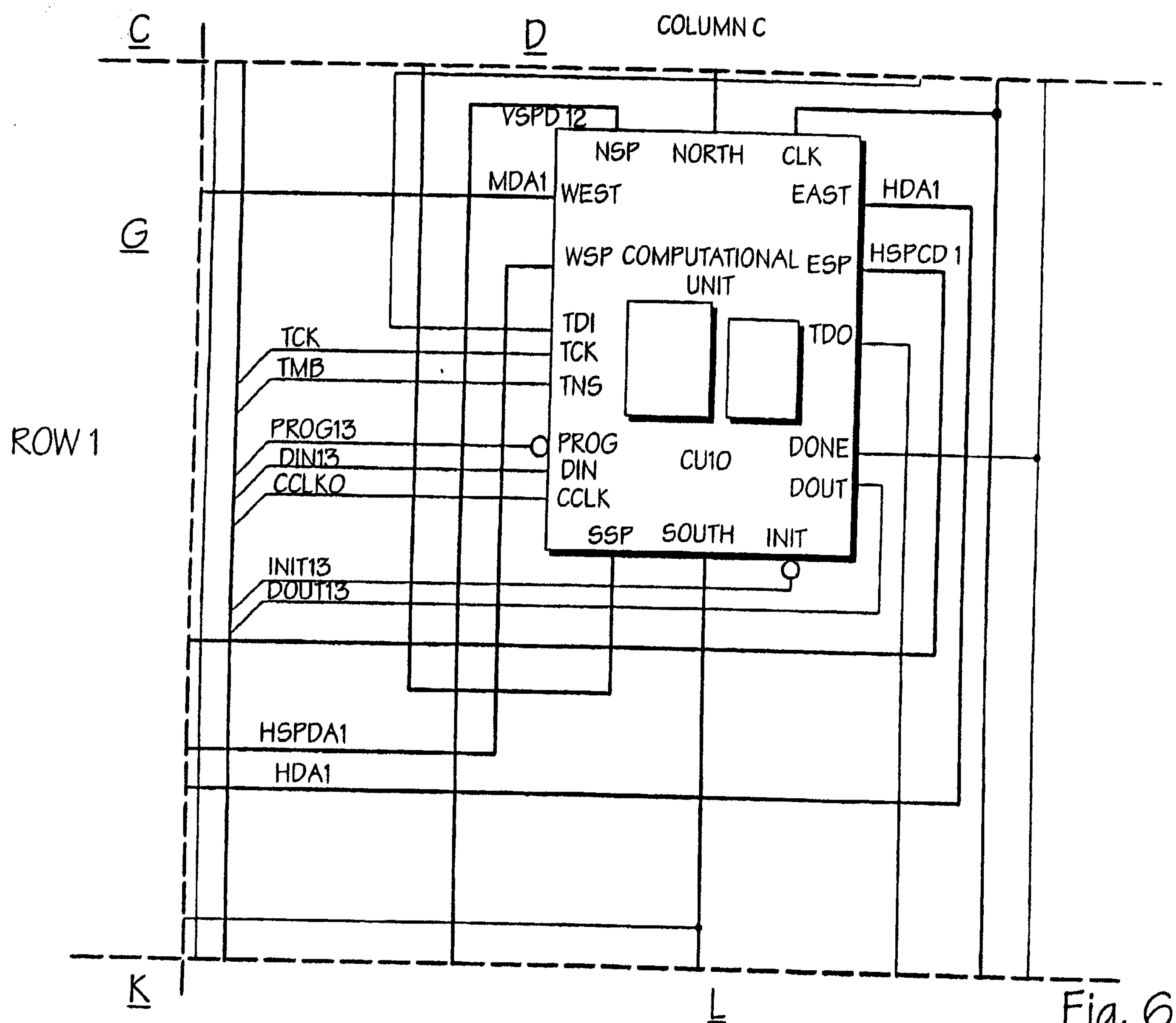

C
D
COLUMN C
G
ROW 1
K
L
VSPD12
NSP
NORTH
CLK
MDA1
WEST
EAST
HDA1
WSP
COMPUTATIONAL UNIT
ESP
HSPCD 1
TCK
TMB
TDI
TCK
TNS
TDO
PROG13
DIN13
CCLKO
PROG
DIN
CCLK
CU10
DONE
DOUT
SSP
SOUTH
INIT
INIT13
DOUT13
HSPDA1
HDA1

Fig. 60H

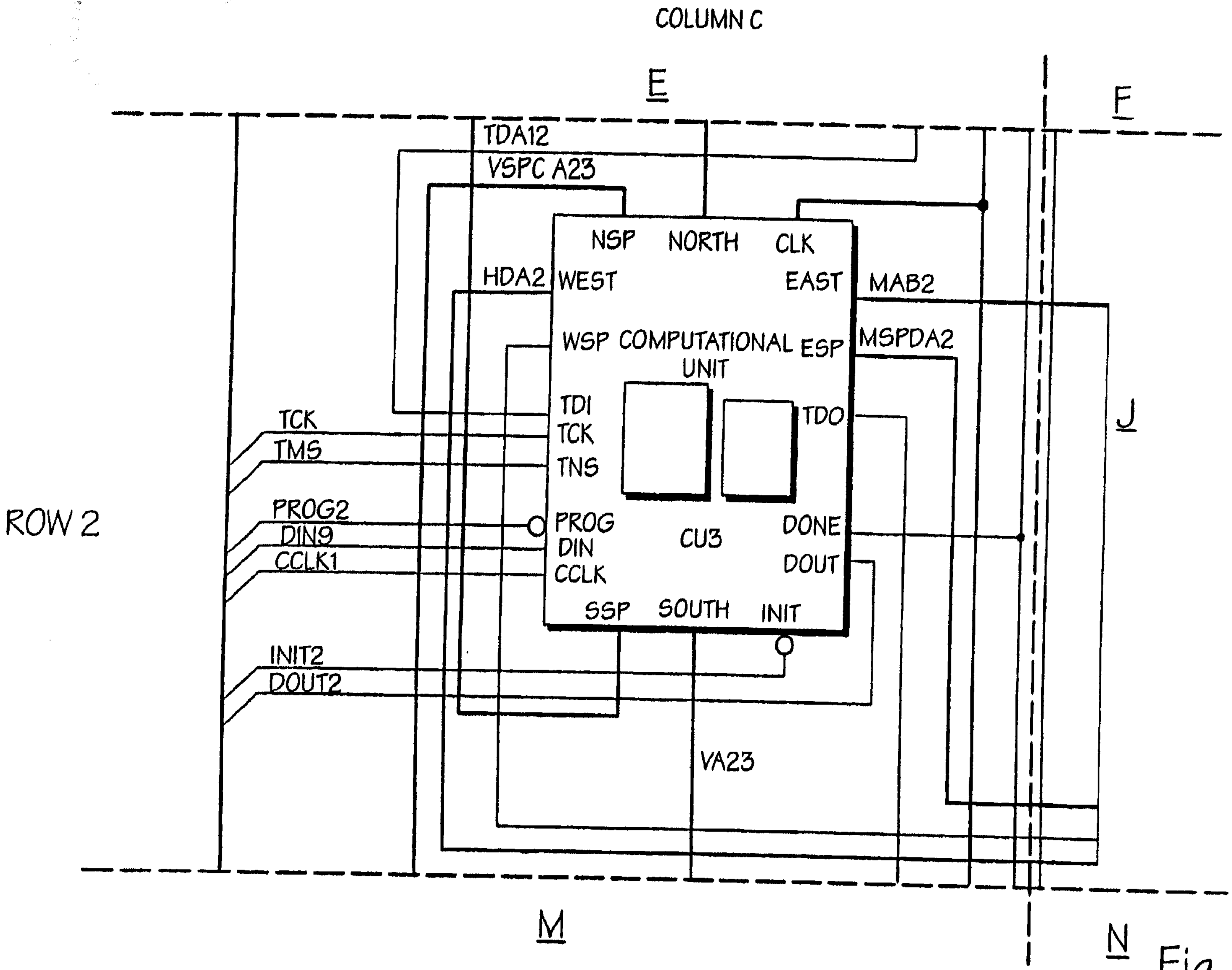

COLUMN C
E
F
TDA12
VSPC A23
NSP
NORTH
CLK
HDA2
WEST
EAST
MAB2
WSP
COMPUTATIONAL UNIT
ESP
MSPDA2
TDI
TCK
TNS
TDO
J
TCK
TMS
ROW 2
PROG2
DIN9
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT2
DOUT2
VA23
M
N

Fig. 601

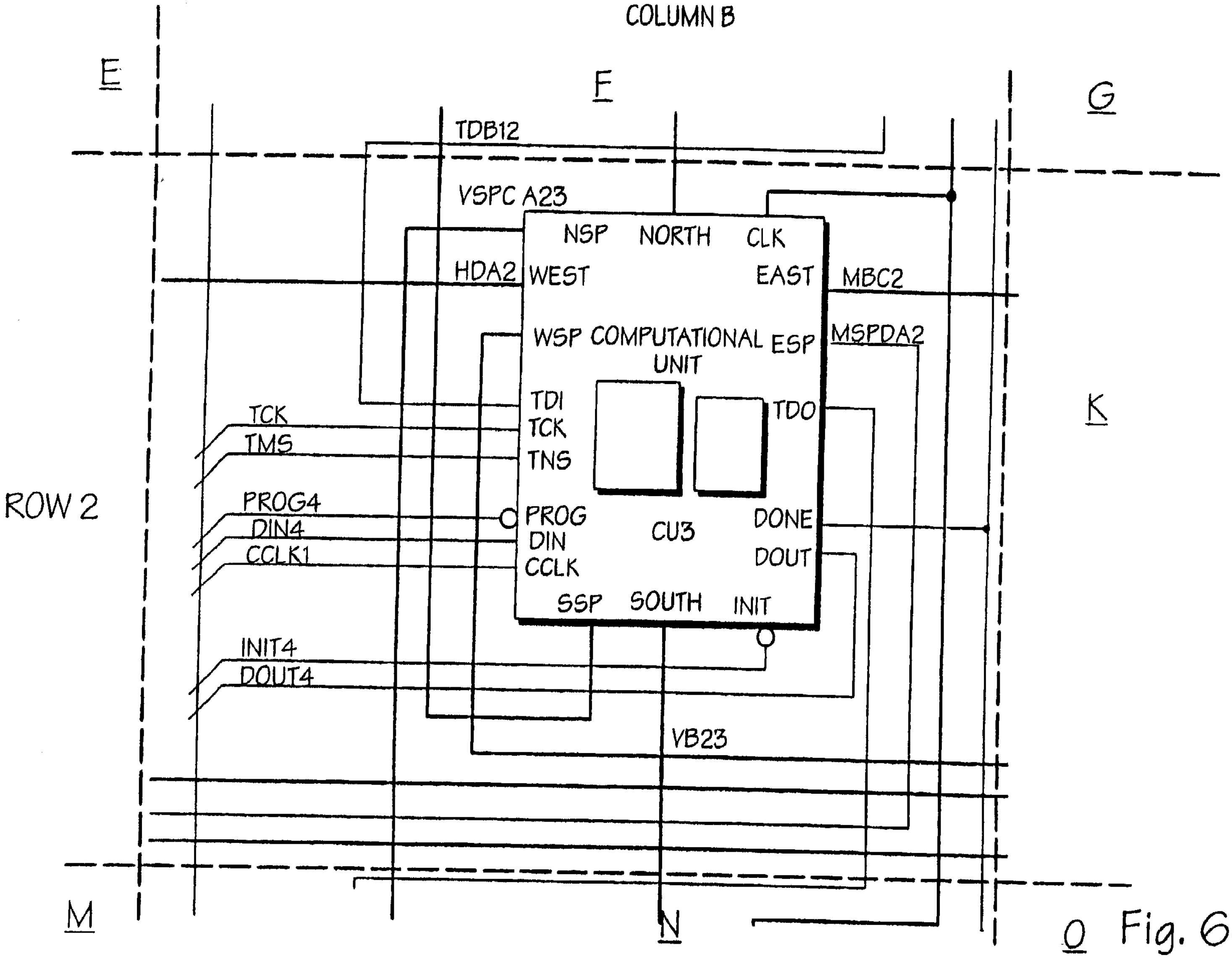

COLUMN B
E
F
G
TDB12
VSPC A23
NSP
NORTH
CLK
HDA2
WEST
EAST
MBC2
WSP
COMPUTATIONAL UNIT
ESP
MSPDA2
TDI
TCK
TNS
TDO
K
TCK
TMS
ROW 2
PROG4
DIN4
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT4
DOUT4
VB23
M
N
O

Fig. 60J

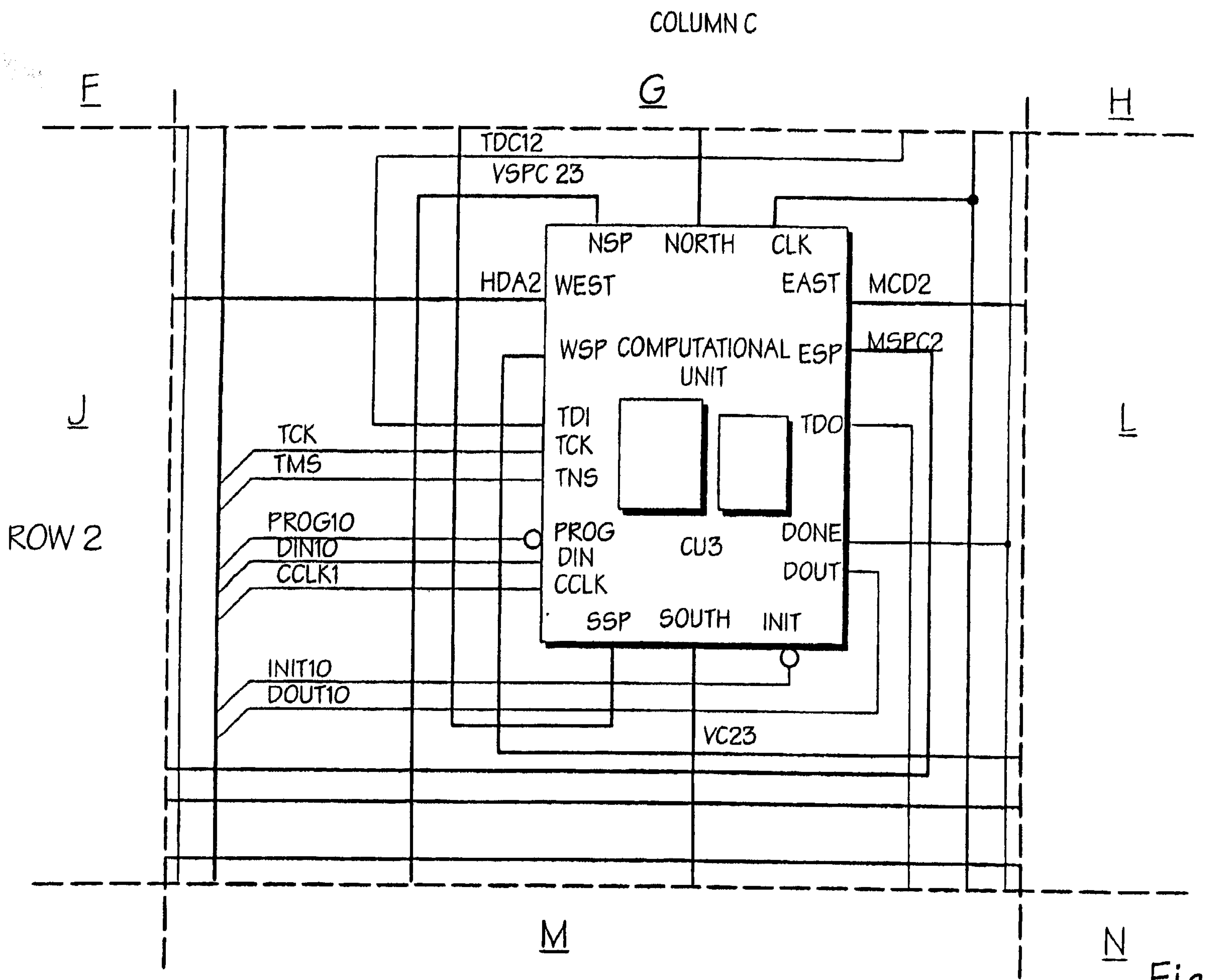

COLUMN C
F
G
H
TDC12
VSPC 23
NSP
NORTH
CLK
HDA2
WEST
EAST
MCD2
WSP
COMPUTATIONAL
UNIT
ESP
MSPC2
J
L
TDI
TCK
TNS
TDO
TCK
TMS
ROW 2
PROG10
DIN10
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT10
DOUT10
VC23
M
N

Fig. 60K

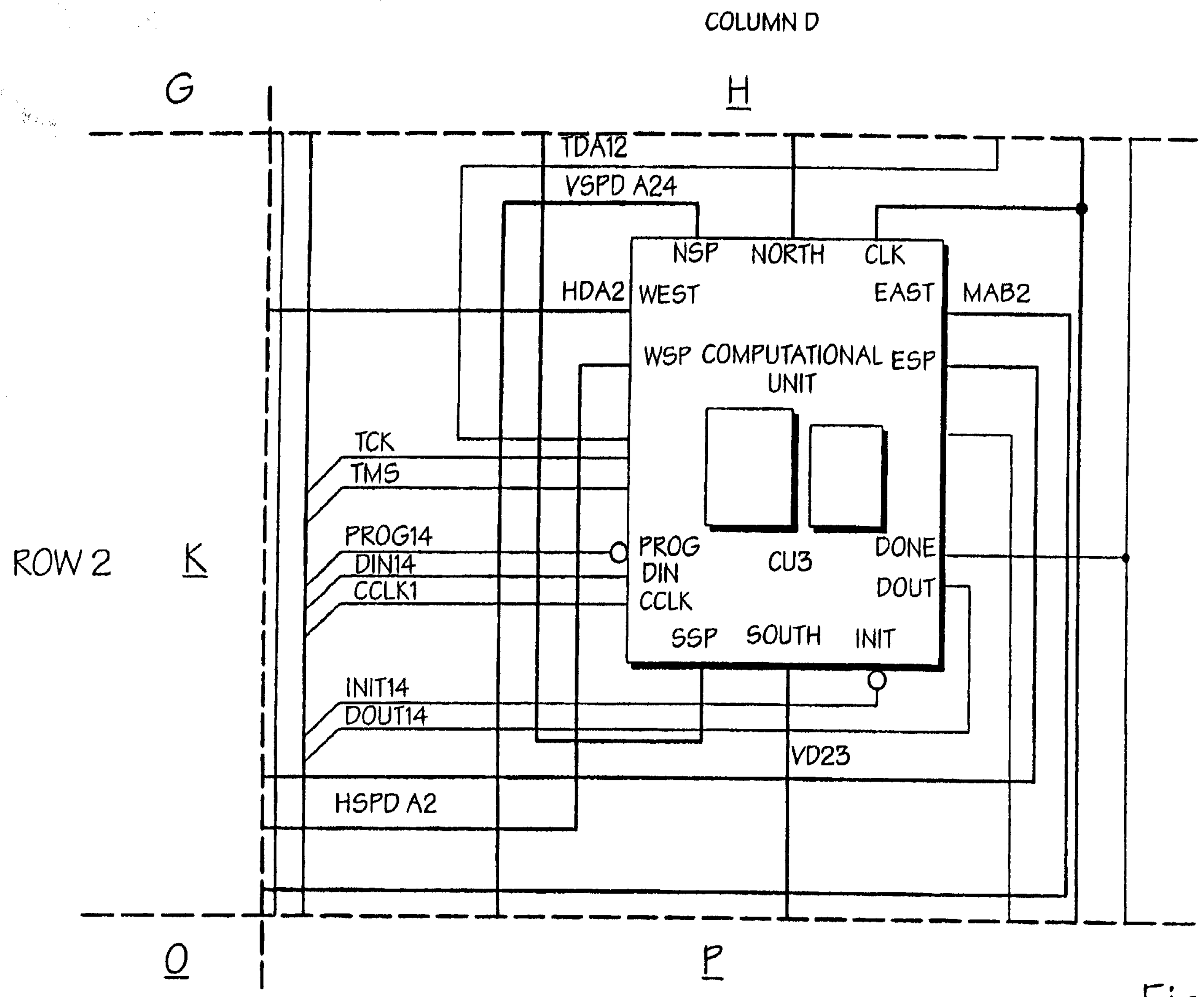

COLUMN D
G
H
ROW 2
K
O
P
TDA12
VSPD A24
HDA2
NSP
NORTH
CLK
WEST
EAST
MAB2
WSP
COMPUTATIONAL UNIT
ESP
TCK
TMS
PROG14
DIN14
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT14
DOUT14
VD23
HSPD A2

Fig. 60L

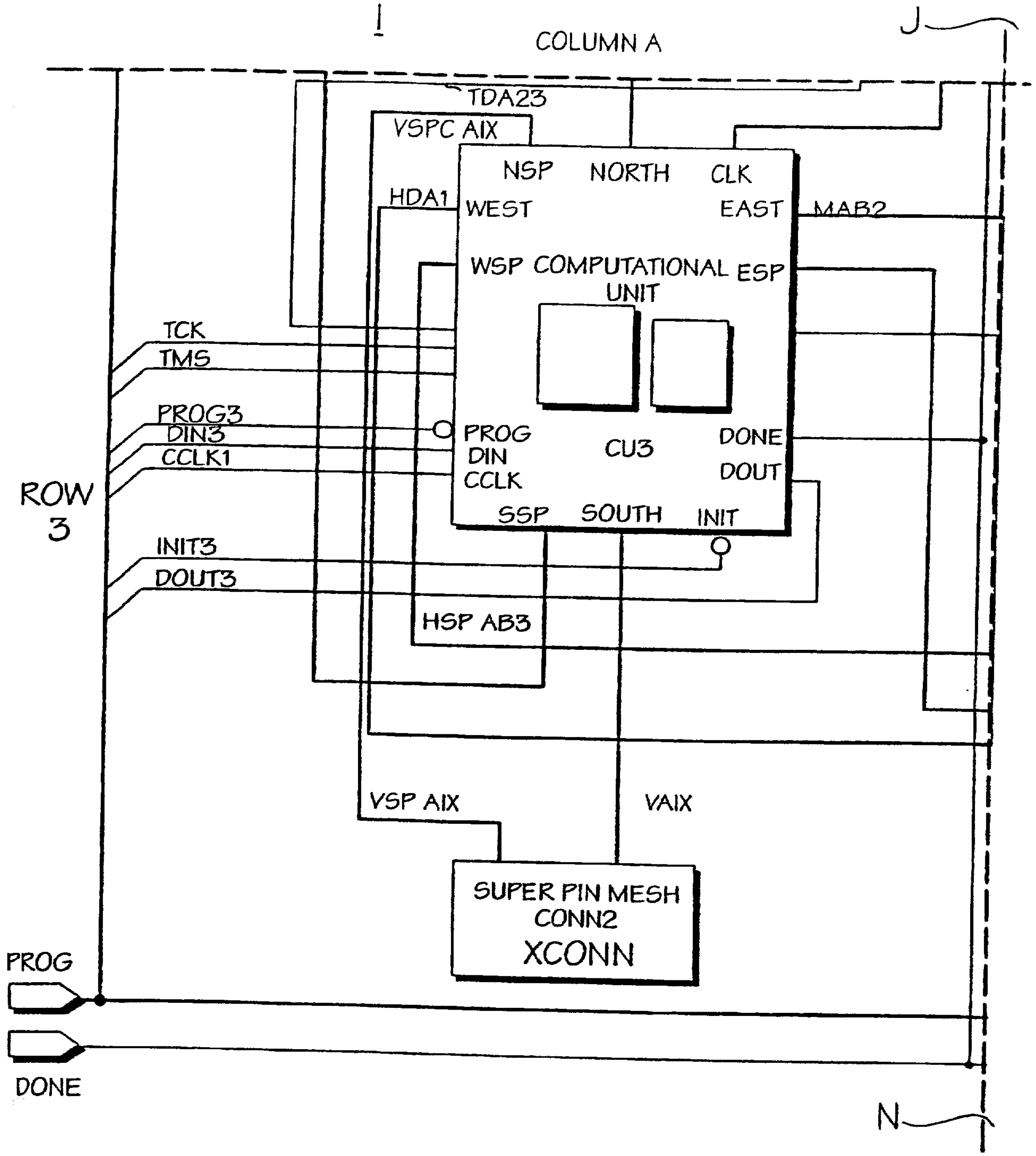

I
COLUMN A
J
TDA23
VSPC AIX
NSP
NORTH
CLK
HDA1
WEST
EAST
MAB2
WSP
COMPUTATIONAL UNIT
ESP
TCK
TMS
PROG3
DIN3
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
ROW 3
SSP
SOUTH
INIT
INIT3
DOUT3
HSP AB3
VSP AIX
VAIX
SUPER PIN MESH CONN2
XCONN
PROG
DONE
N

Fig. 60M

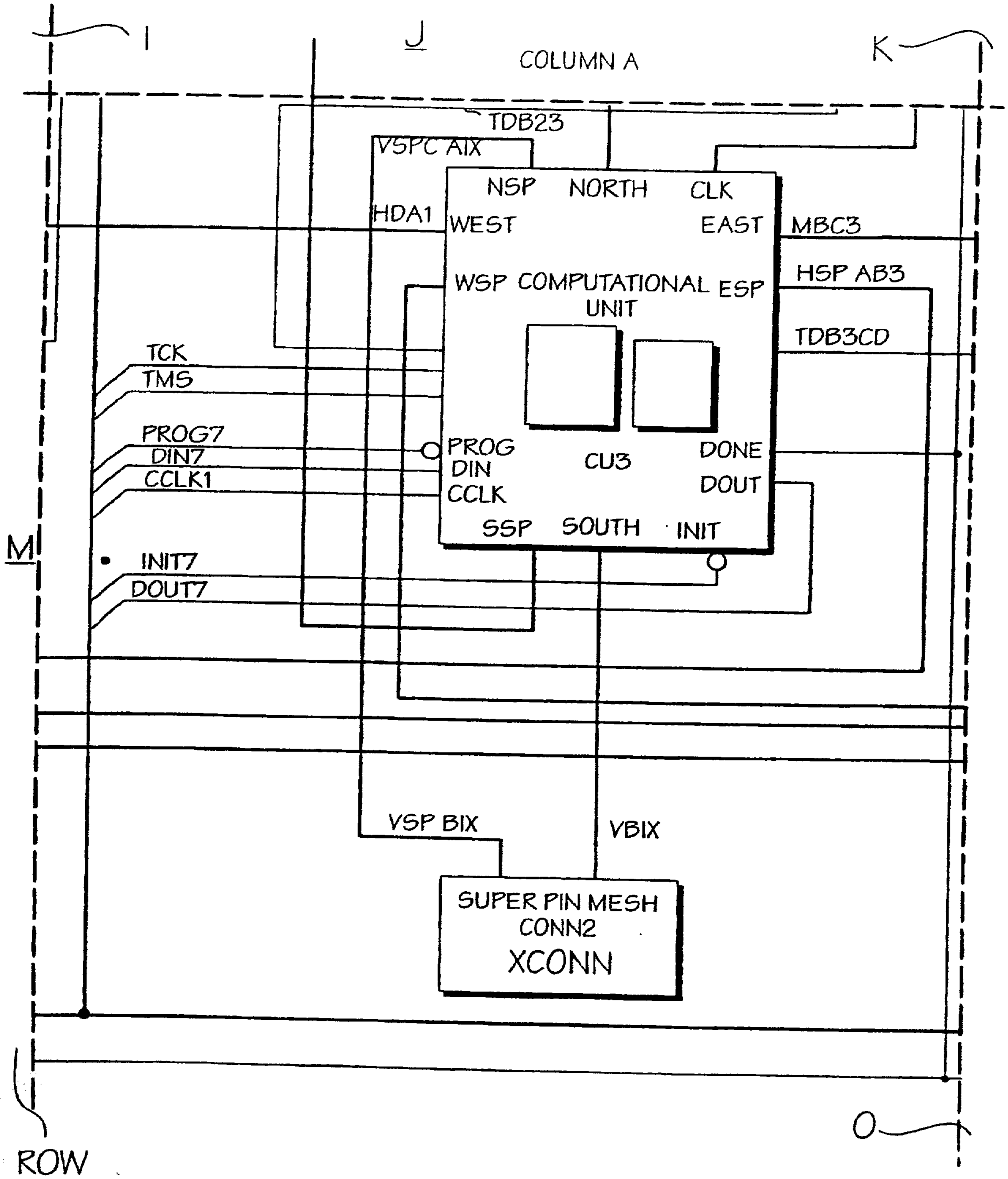

I
J
K
COLUMN A
TDB23
VSPC AIX
NSP
NORTH
CLK
HDA1
WEST
EAST
MBC3
WSP
COMPUTATIONAL UNIT
ESP
HSP AB3
TDB3CD
TCK
TMS
PROG7
DIN7
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
M
INIT7
DOUT7
VSP BIX
VBIX
SUPER PIN MESH
CONN2
XCONN
ROW 3
O

Fig. 60N

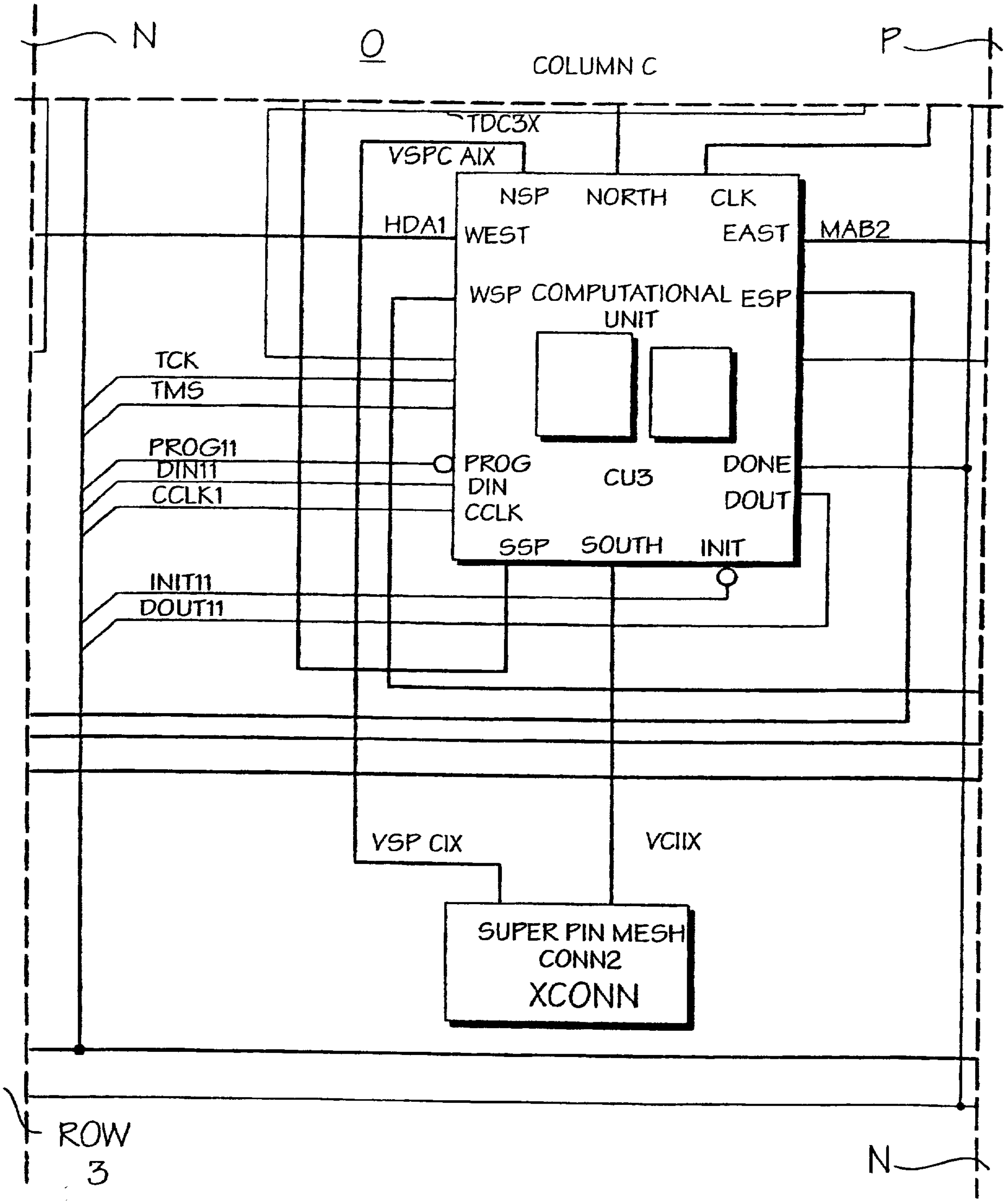

N
O
P
COLUMN C
TDC3X
VSPC AIX
NSP
NORTH
CLK
HDA1
WEST
EAST
MAB2
WSP
COMPUTATIONAL UNIT
ESP
TCK
TMS
PROG11
DIN11
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT11
DOUT11
VSP CIX
VCIIX
SUPER PIN MESH
CONN2
XCONN
ROW
3
N

Fig. 600

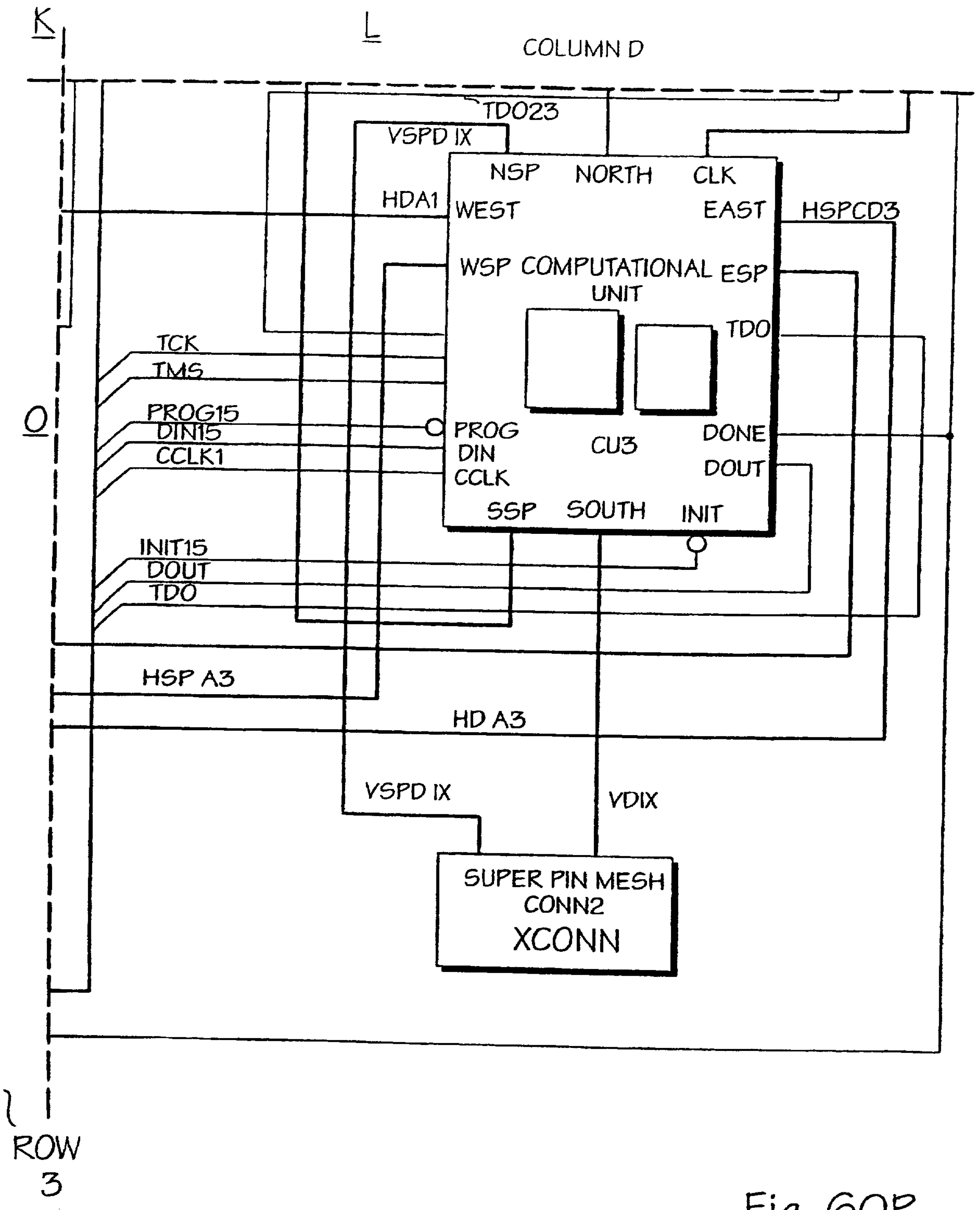

K
L
COLUMN D
TDO23
VSPD IX
NSP
NORTH
CLK
HDA1
WEST
EAST
HSPCD3
WSP
COMPUTATIONAL UNIT
ESP
TDO
TCK
TMS
O
PROG15
DIN15
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT15
DOUT
TDO
HSP A3
HD A3
VSPD IX
VDIX
SUPER PIN MESH
CONN2
XCONN
ROW
3

Fig. 60P

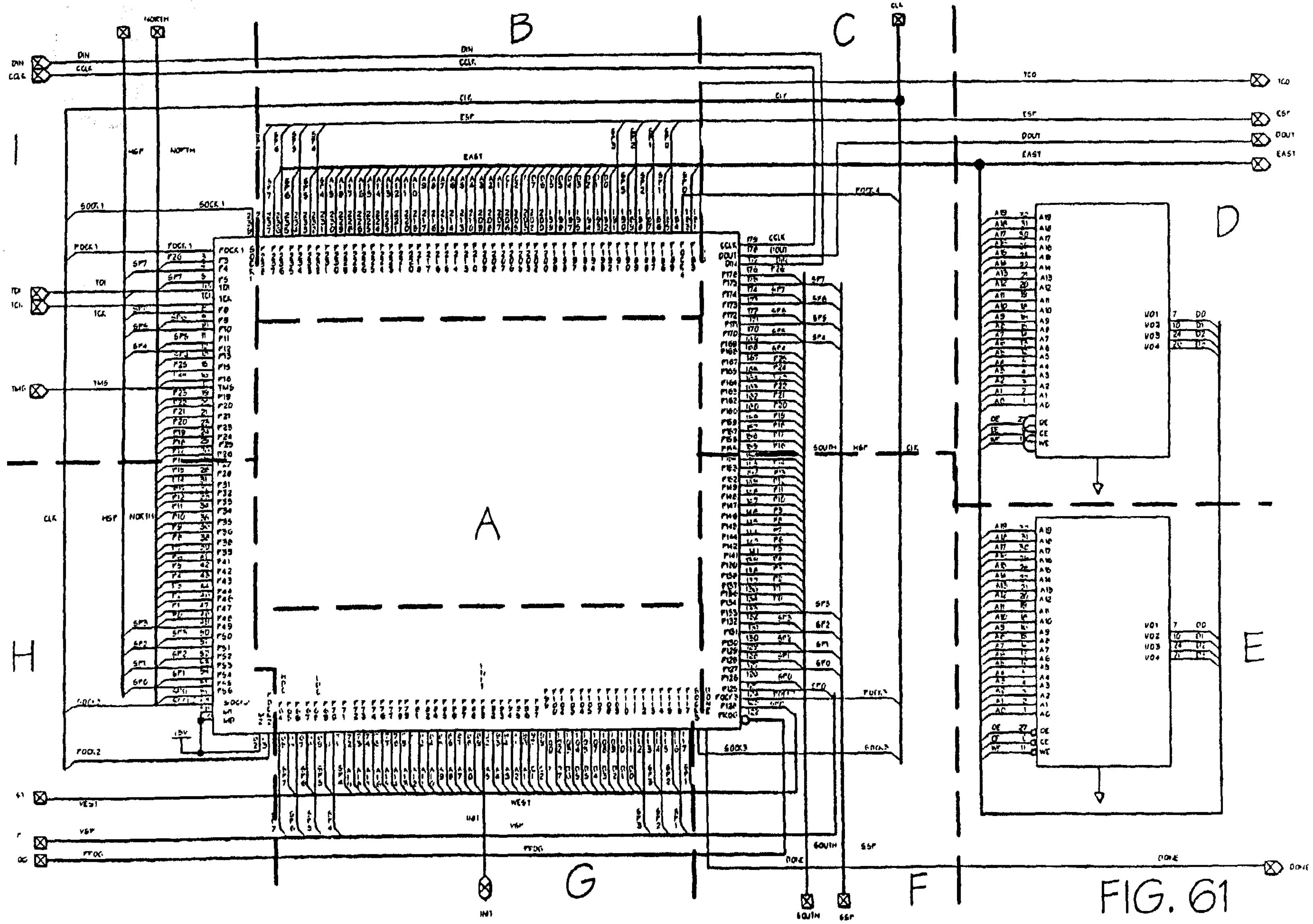

A
B
C
D
E
F
G
H
I
DIN
CCLK
CLK
ESP
EAST
TCO
DOUT
NORTH
HSP
TDI
TCK
TMS
SOCK1
FOCK1
FOCK2
FOCK3
FOCK4
SOCK3
SOUTH
WEST
VSP
PROG
DONE
INIT
A0–A19
OE
CE
WE
I/O1
I/O2
I/O3
I/O4
D0
D1
D2
D3

FIG. 61

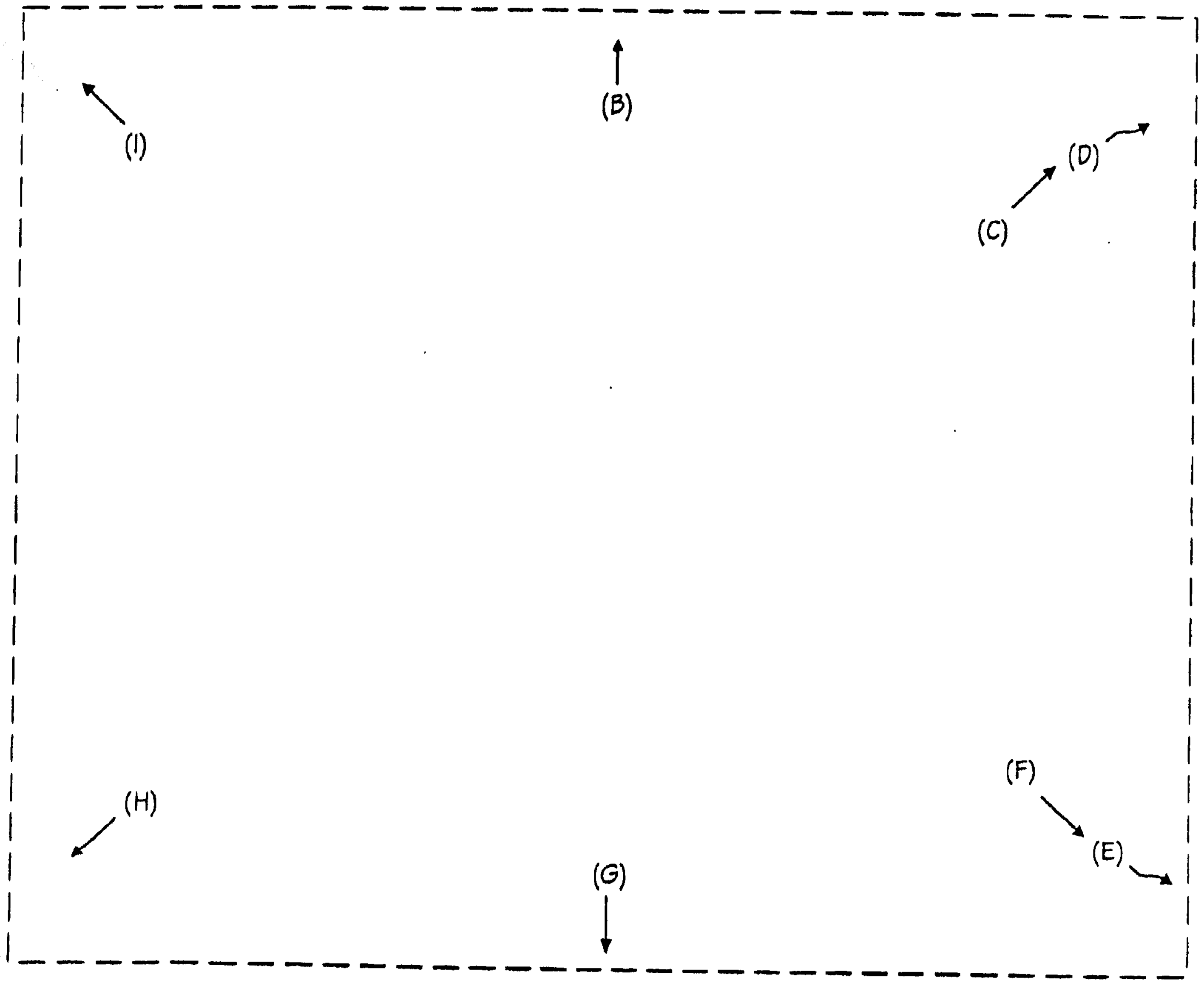


FIG. 61(A)

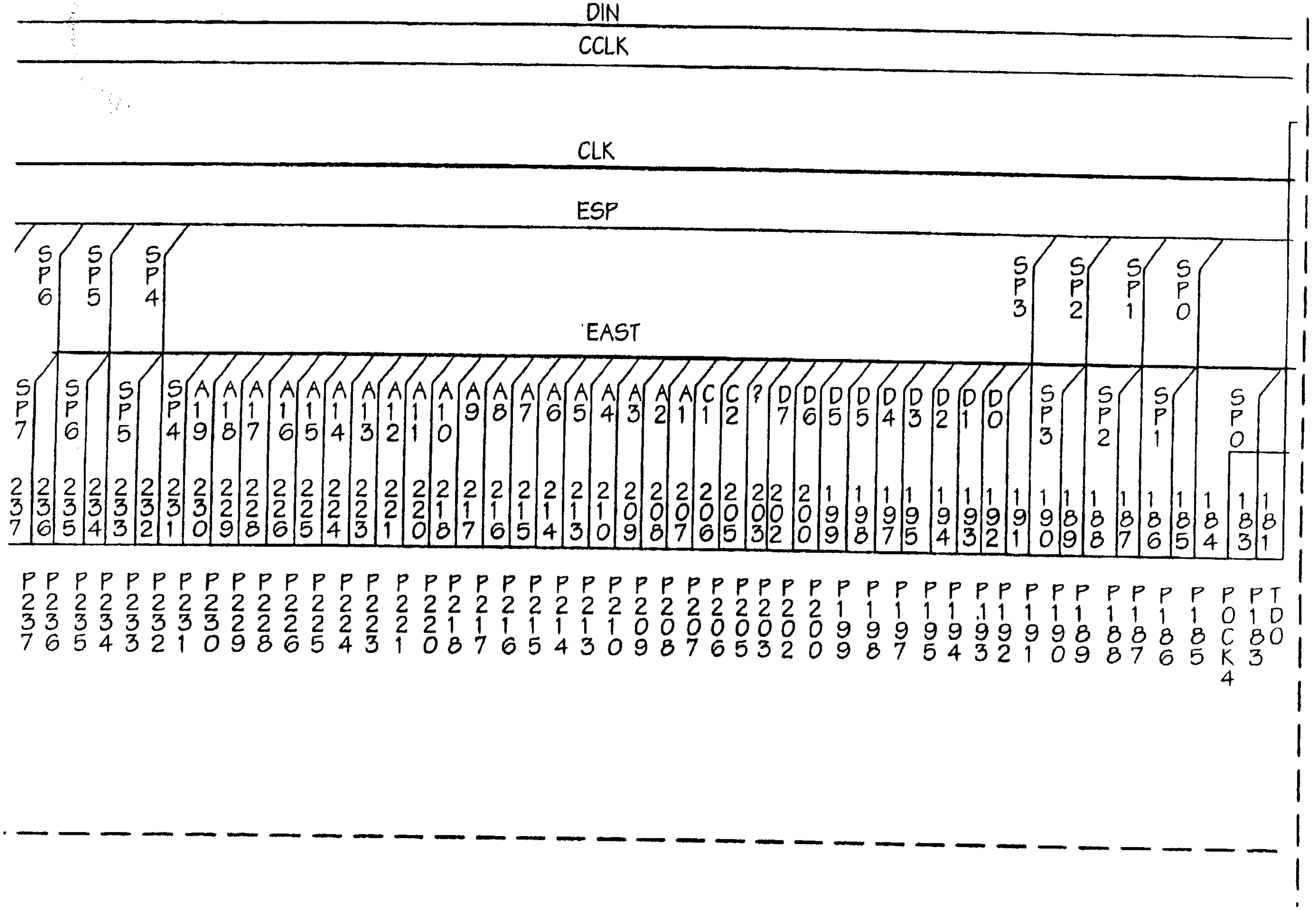
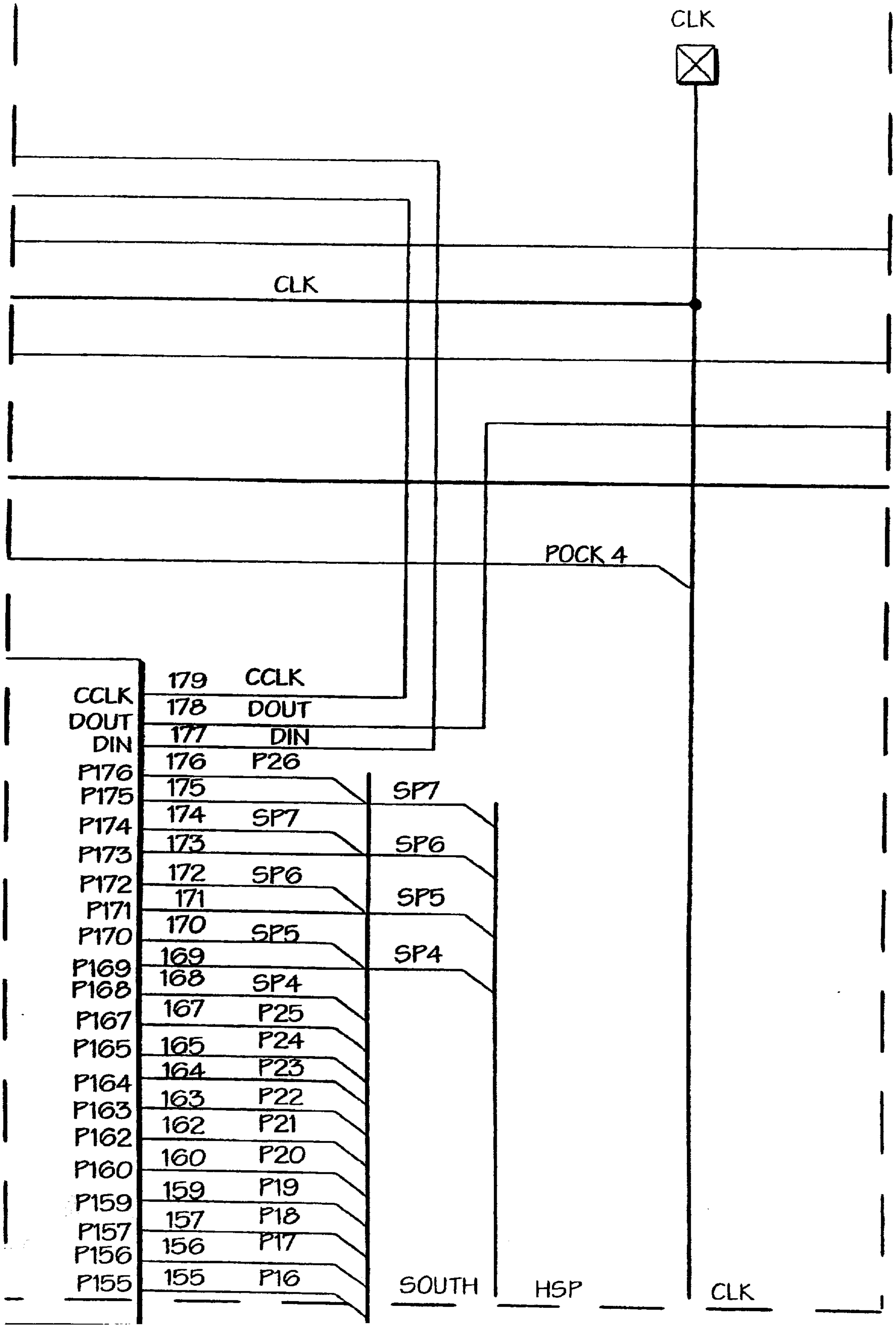

DIN
CCLK
CLK
ESP
EAST
SP6
SP5
SP4
SP3
SP2
SP1
SP0
SP7
SP6
SP5
SP4
A19
A18
A17
A16
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
C1
C2
?
D7
D6
D5
D5
D4
D3
D2
D1
D0
SP3
SP2
SP1
SP0
237
236
235
234
233
232
231
230
229
228
226
225
224
223
221
220
218
217
216
215
214
213
210
209
208
207
206
205
203
202
200
199
198
197
195
194
193
192
191
190
189
188
187
186
185
184
183
181
P237
P236
P235
P234
P233
P232
P231
P230
P229
P228
P226
P225
P224
P223
P221
P220
P218
P217
P216
P215
P214
P213
P210
P209
P208
P207
P206
P205
P203
P202
P200
P199
P198
P197
P195
P194
P193
P192
P191
P190
P189
P188
P187
P186
P185
P0CK4
P183
TD0

FIG. 61(B)


CLK
CLK
POCK 4
179
178
177
176
175
174
173
172
171
170
169
168
167
165
164
163
162
160
159
157
156
155
CCLK
DOUT
DIN
P176
P175
P174
P173
P172
P171
P170
P169
P168
P167
P165
P164
P163
P162
P160
P159
P157
P156
P155
CCLK
DOUT
DIN
P26
SP7
SP6
SP5
SP4
P25
P24
P23
P22
P21
P20
P19
P18
P17
P16
SP7
SP6
SP5
SP4
SOUTH
HSP
CLK

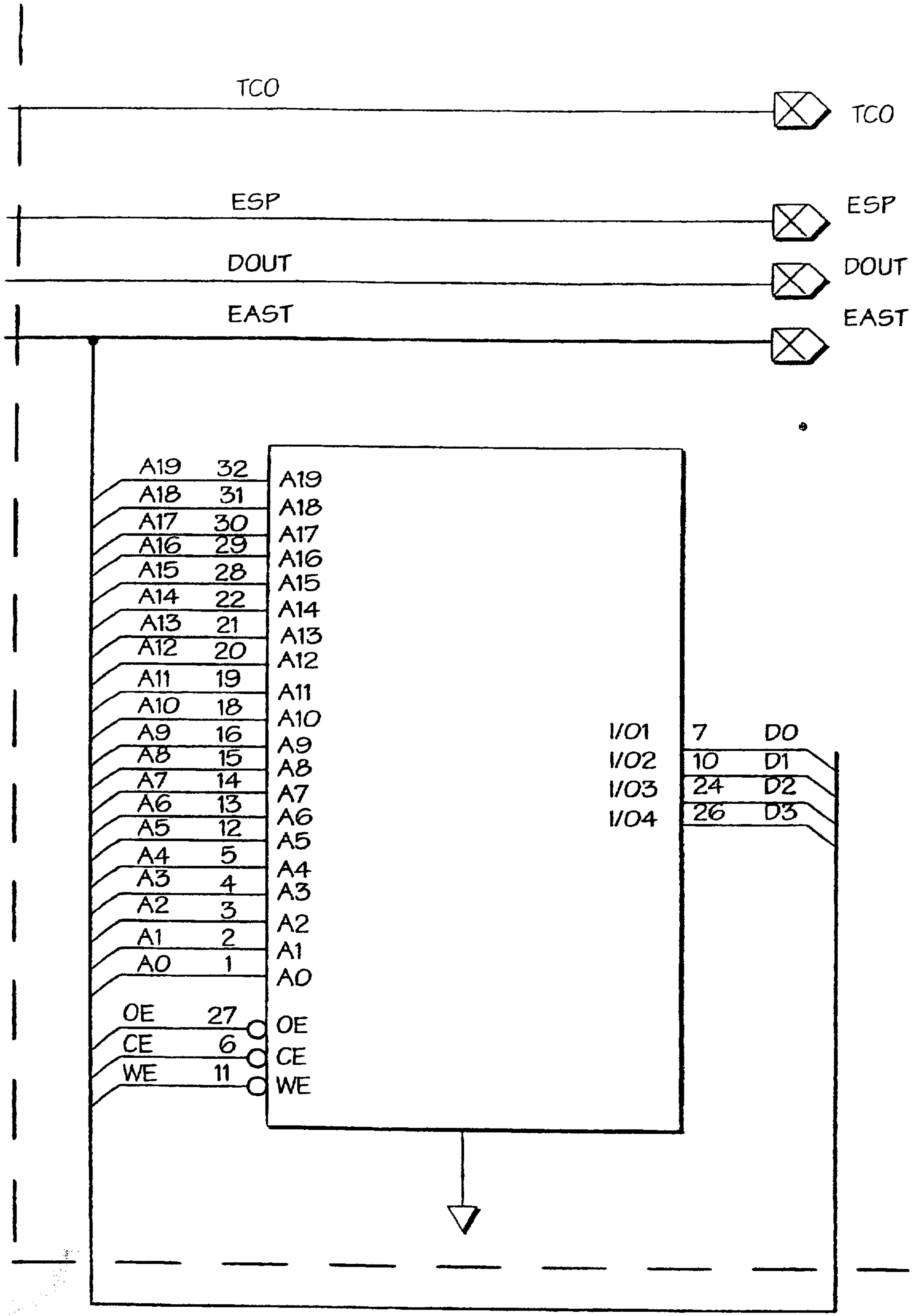

TCO
TCO
ESP
ESP
DOUT
DOUT
EAST
EAST
A19 32 A19
A18 31 A18
A17 30 A17
A16 29 A16
A15 28 A15
A14 22 A14
A13 21 A13
A12 20 A12
A11 19 A11
A10 18 A10
A9 16 A9
A8 15 A8
A7 14 A7
A6 13 A6
A5 12 A5
A4 5 A4
A3 4 A3
A2 3 A2
A1 2 A1
A0 1 A0
OE 27 OE
CE 6 CE
WE 11 WE
I/01 7 D0
I/02 10 D1
I/03 24 D2
I/04 26 D3

FIG. 61(D)

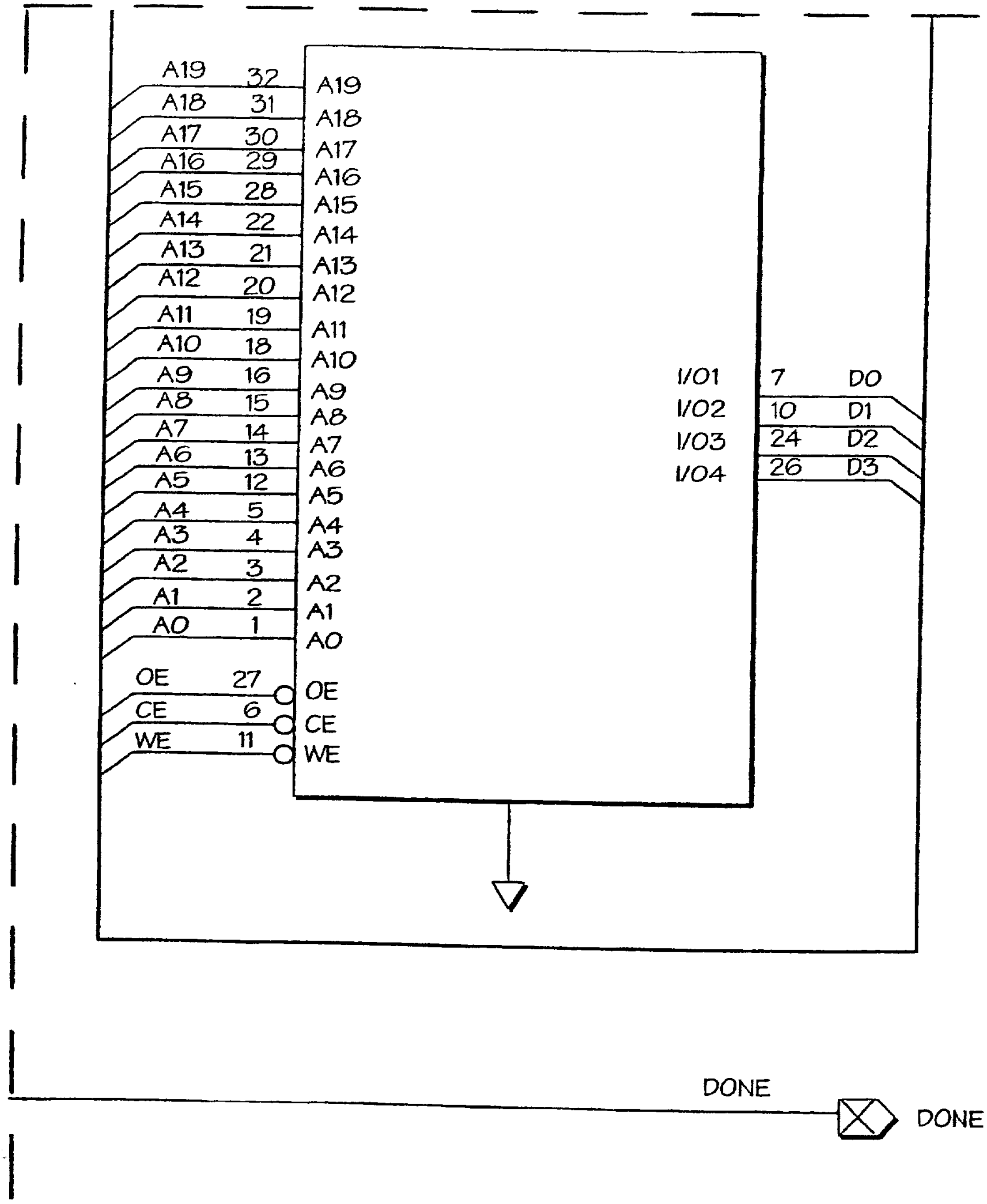

A19 32 A19
A18 31 A18
A17 30 A17
A16 29 A16
A15 28 A15
A14 22 A14
A13 21 A13
A12 20 A12
A11 19 A11
A10 18 A10
A9 16 A9
A8 15 A8
A7 14 A7
A6 13 A6
A5 12 A5
A4 5 A4
A3 4 A3
A2 3 A2
A1 2 A1
A0 1 A0
OE 27 OE
CE 6 CE
WE 11 WE
I/O1 7 D0
I/O2 10 D1
I/O3 24 D2
I/O4 26 D3
DONE
DONE

FIG. 61(E)

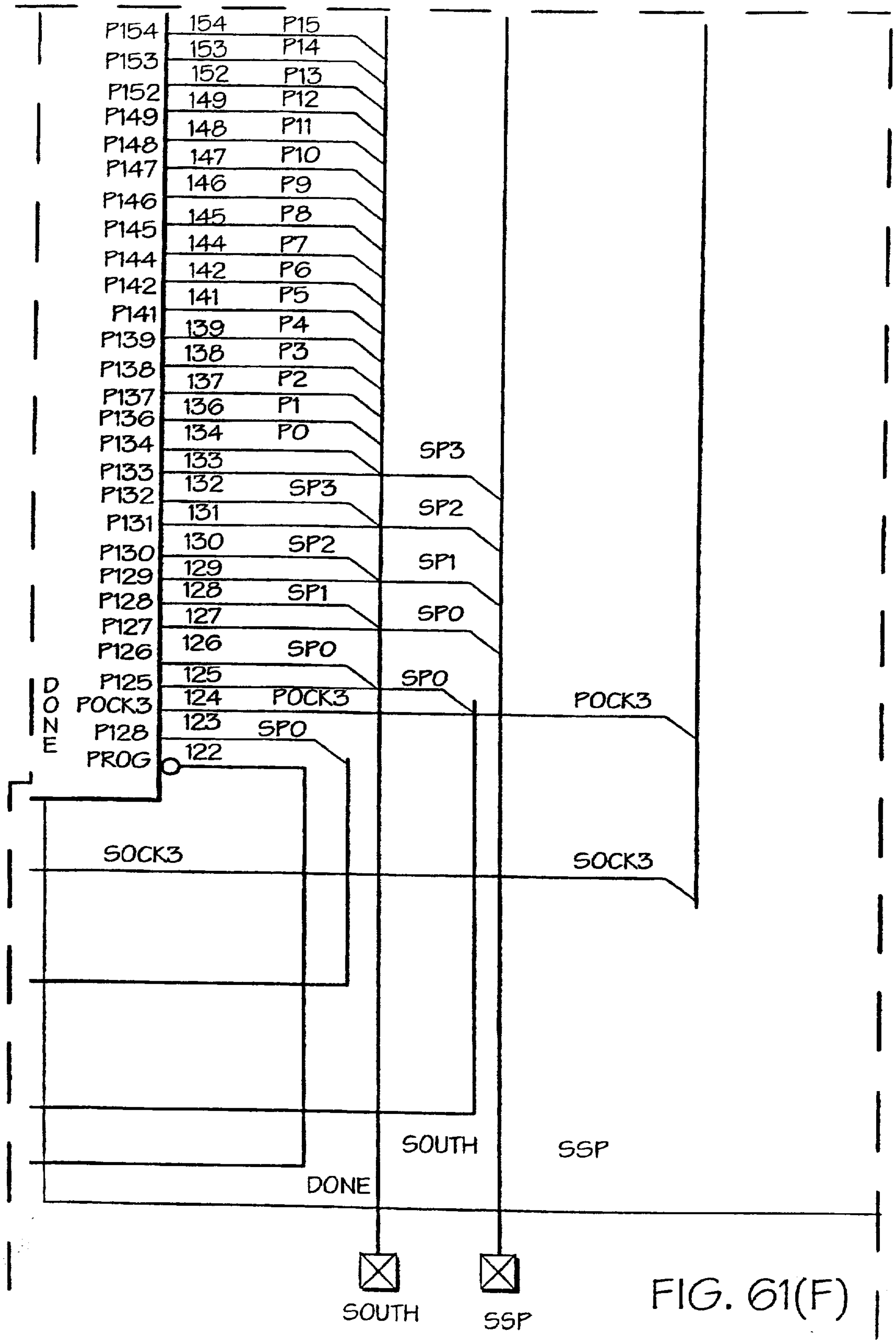

P154
P153
P152
P149
P148
P147
P146
P145
P144
P142
P141
P139
P138
P137
P136
P134
P133
P132
P131
P130
P129
P128
P127
P126
P125
POCK3
P128
PROG
DONE
154
153
152
149
148
147
146
145
144
142
141
139
138
137
136
134
133
132
131
130
129
128
127
126
125
124
123
122
P15
P14
P13
P12
P11
P10
P9
P8
P7
P6
P5
P4
P3
P2
P1
P0
SP3
SP2
SP1
SP0
SP0
POCK3
SP0
SP3
SP2
SP1
SP0
SP0
POCK3
SOCK3
SOCK3
SOUTH
SSP
DONE
SOUTH
SSP

FIG. 61(F)

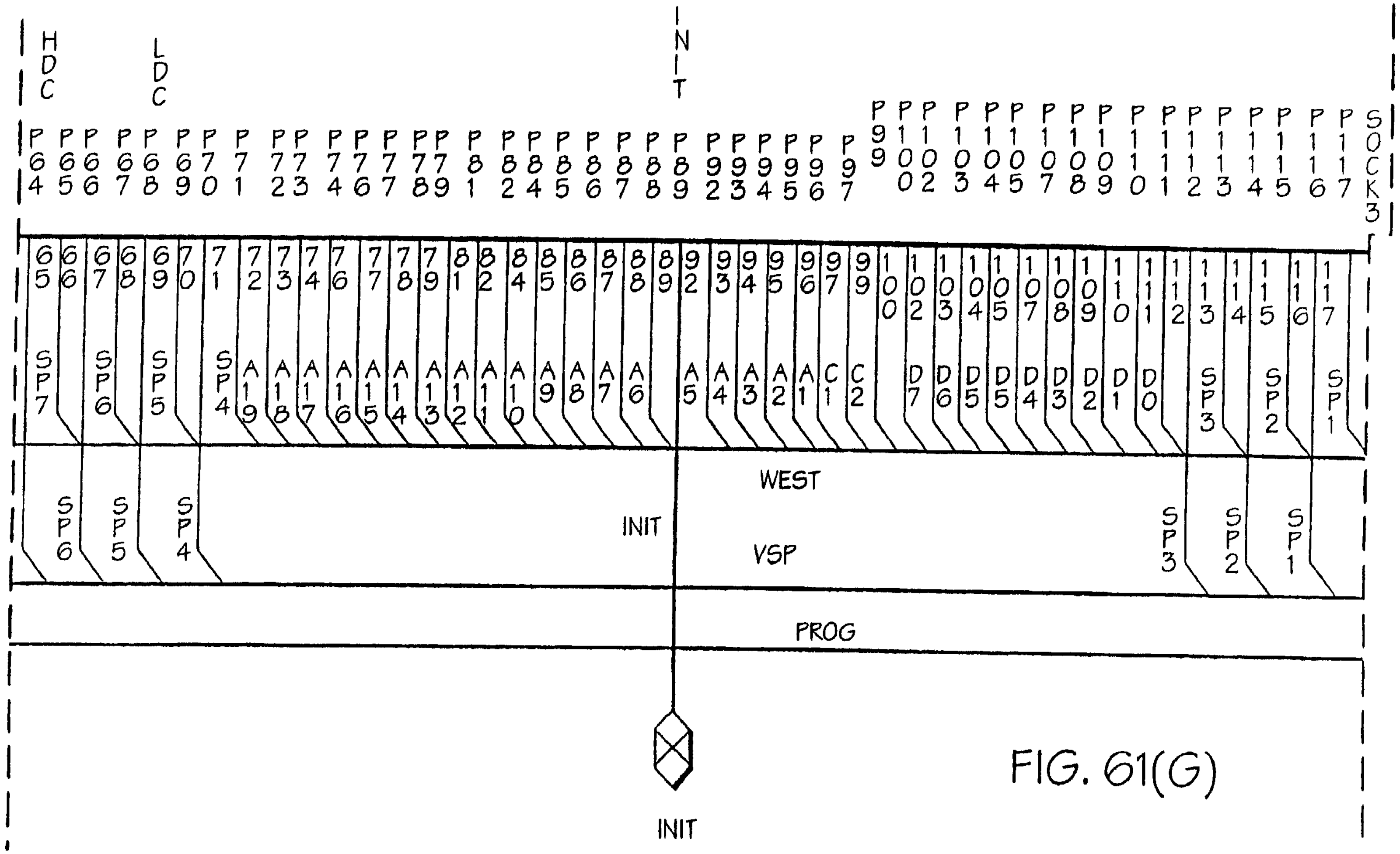

HDC
LDC
INIT
SOCK3
P664 P665 P666 P667 P668 P669 P670 P671 P672 P673 P674 P676 P677 P678 P679 P681 P682 P684 P685 P686 P687 P688 P689 P692 P693 P694 P695 P696 P697 P699 P1000 P1002 P1003 P1004 P1005 P1007 P1008 P1009 P1110 P1111 P1112 P1113 P1114 P1115 P1116 P1117
SP7
SP6
SP5
SP4
A19 A18 A17 A16 A15 A14 A13 A12 A11 A10 A9 A8 A7 A6 A5 A4 A3 A2 A1
C1 C2
D7 D6 D5 D5 D4 D3 D2 D1 D0
SP3
SP2
SP1
WEST
INIT
VSP
SP6
SP5
SP4
SP3
SP2
SP1
PROG
INIT

FIG. 61(G)

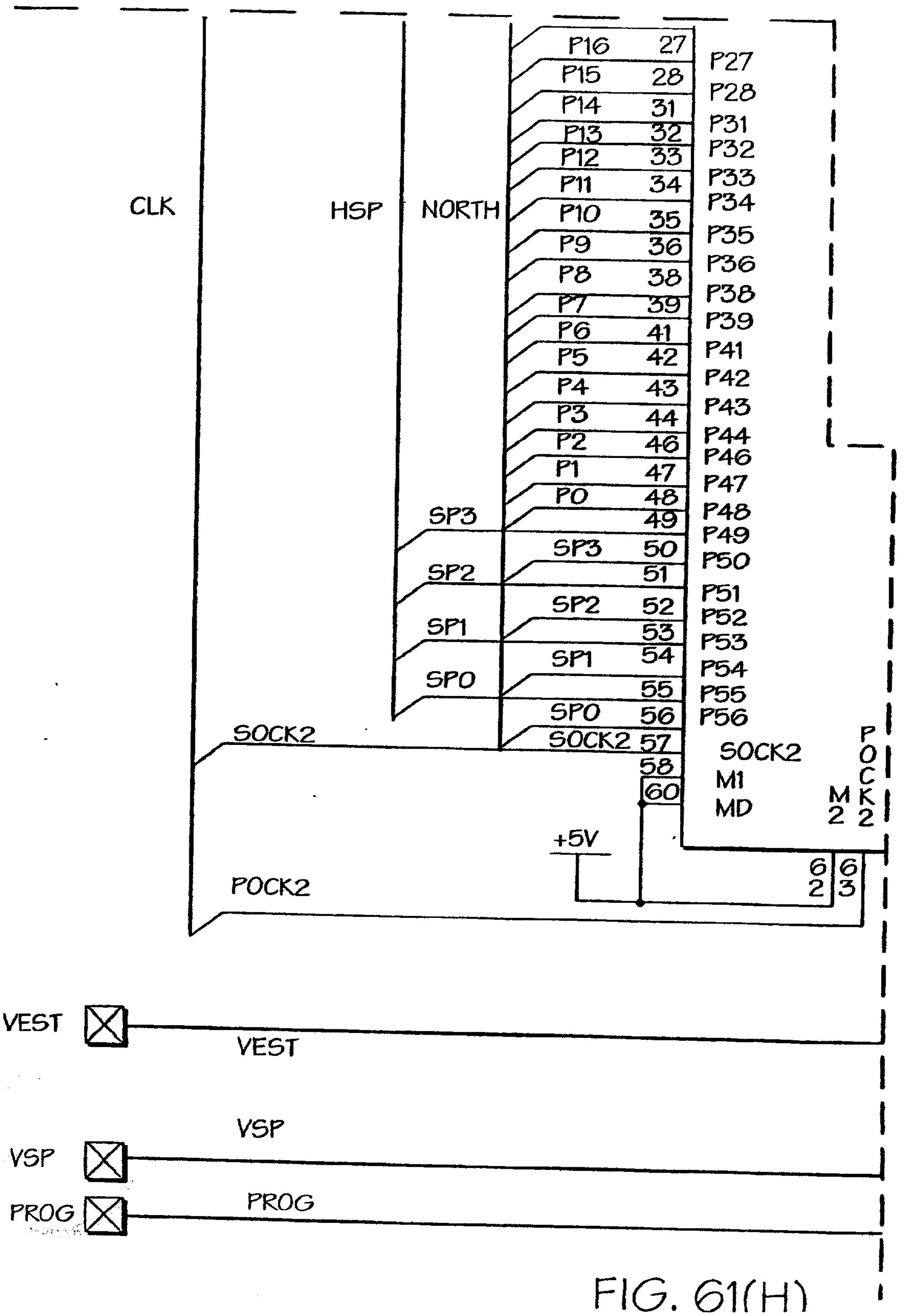

CLK
HSP
NORTH
P16 27
P15 28
P14 31
P13 32
P12 33
P11 34
P10 35
P9 36
P8 38
P7 39
P6 41
P5 42
P4 43
P3 44
P2 46
P1 47
P0 48
49
SP3 50
51
SP2 52
53
SP1 54
55
SP0 56
SOCK2 57
58
60
P27
P28
P31
P32
P33
P34
P35
P36
P38
P39
P41
P42
P43
P44
P46
P47
P48
P49
P50
P51
P52
P53
P54
P55
P56
SOCK2
M1
MD
M2
POCK2
62
63
SP3
SP2
SP1
SP0
SOCK2
+5V
POCK2
VEST
VEST
VSP
VSP
PROG
PROG

FIG. 61(H)

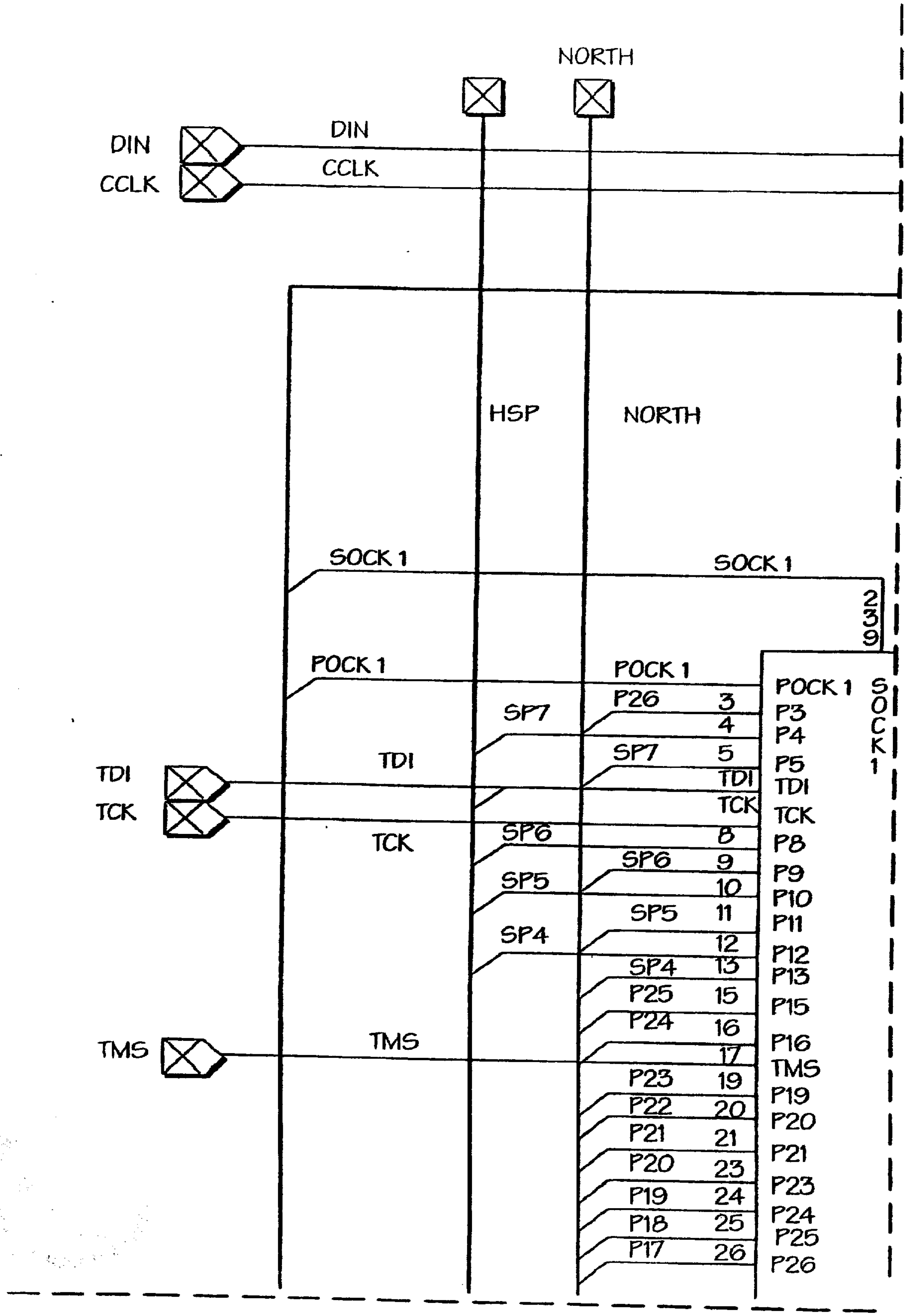

NORTH
DIN
CCLK
DIN
CCLK
HSP
NORTH
SOCK 1
SOCK 1
2
3
9
POCK 1
POCK 1
POCK 1
P26
3
P3
4
P4
SP7
SP7
5
P5
TDI
TDI
TDI
TDI
TCK
TCK
TCK
TCK
SP6
8
P8
SP6
9
P9
SP5
10
P10
SP5
11
P11
SP4
12
P12
SP4
13
P13
P25
15
P15
P24
16
P16
17
TMS
TMS
TMS
P23
19
P19
P22
20
P20
P21
21
P21
P20
23
P23
P19
24
P24
P18
25
P25
P17
26
P26
S
O
C
K
1

FIG. 61(1)

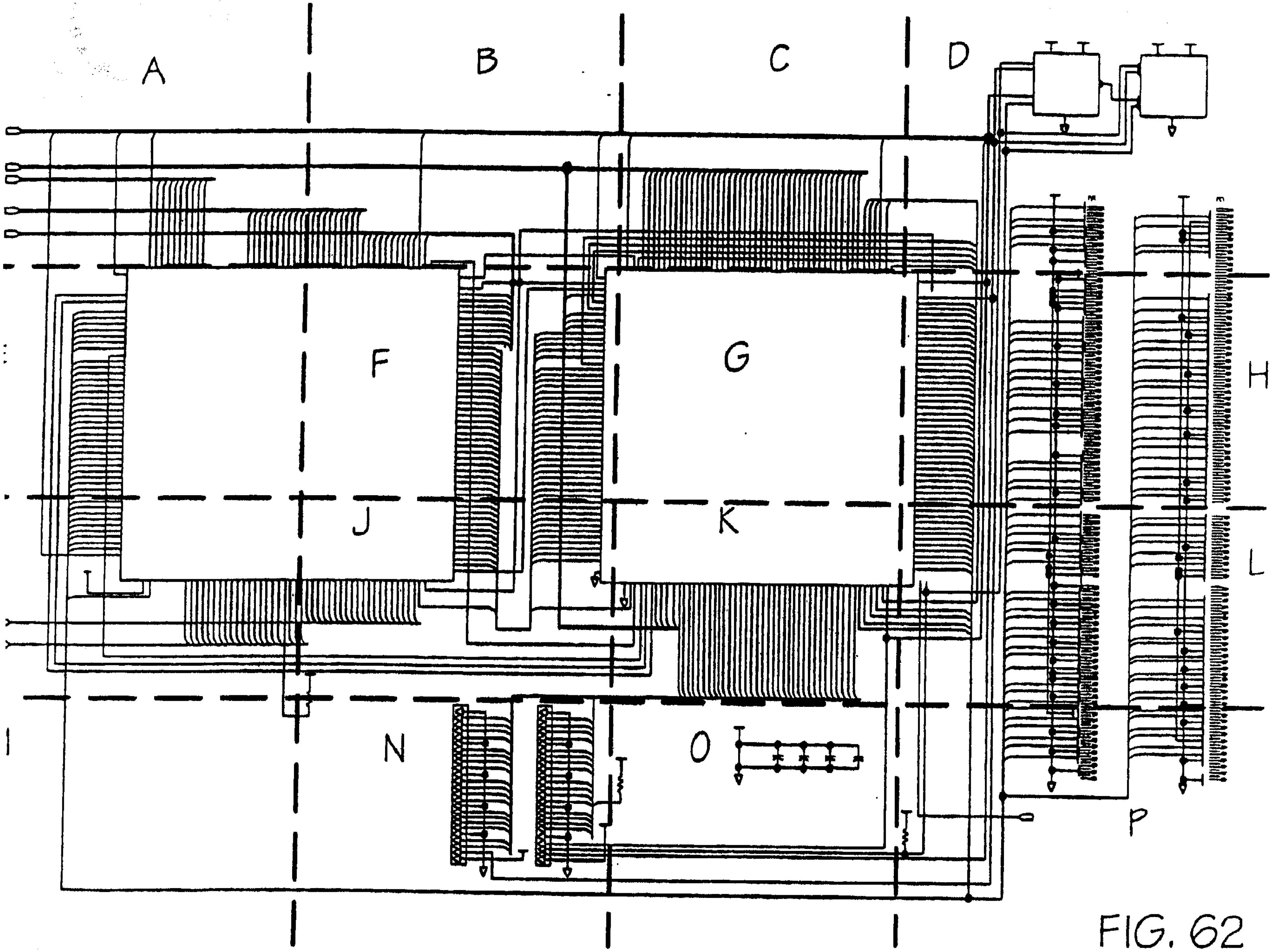
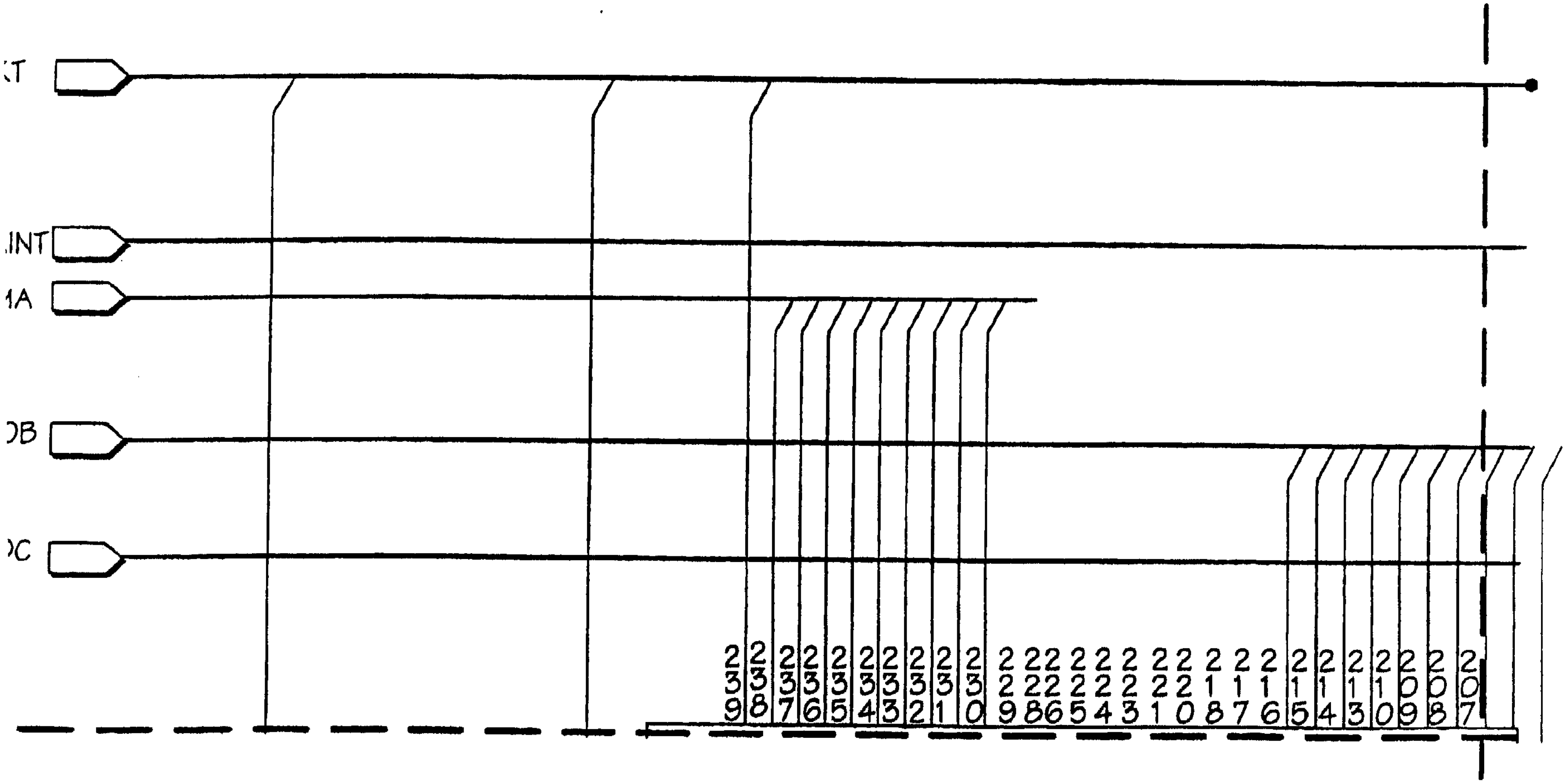


FIG. 62

FIG. 62(A)


T
INT
A
B
C
239
238
237
236
235
234
233
232
231
230
229
228
226
225
224
223
221
220
218
217
216
215
214
213
210
209
208
207

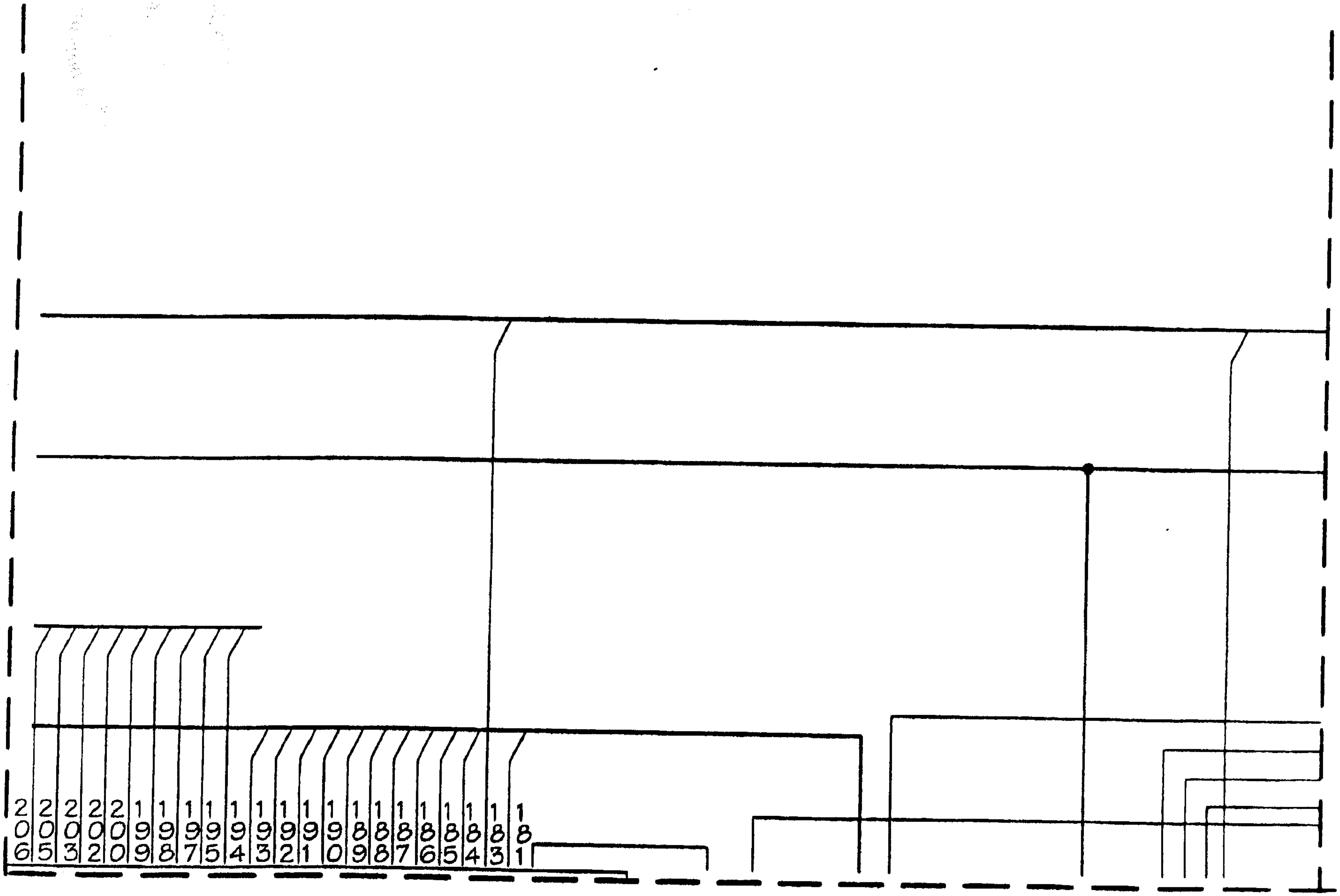

206
205
203
202
200
199
198
197
195
194
193
192
191
190
189
188
187
186
185
184
183
181

FIG. 62(B)

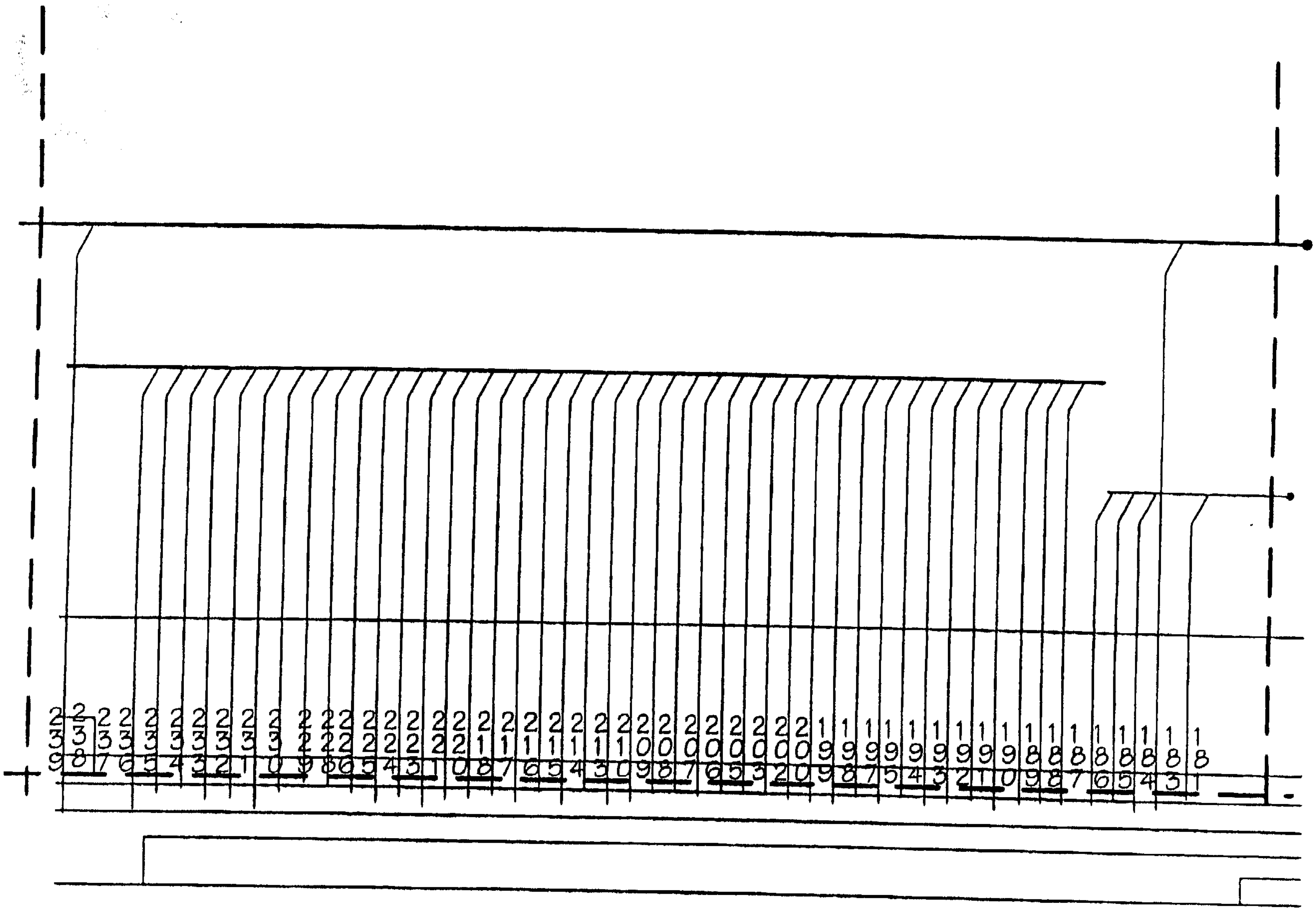

239
238
237
236
235
234
233
232
231
230
229
228
226
225
224
223
221
220
218
217
216
215
214
213
210
209
208
207
206
205
203
202
200
199
198
197
195
194
193
192
191
190
189
188
187
186
185
184
183
181

FIG. 62(C)

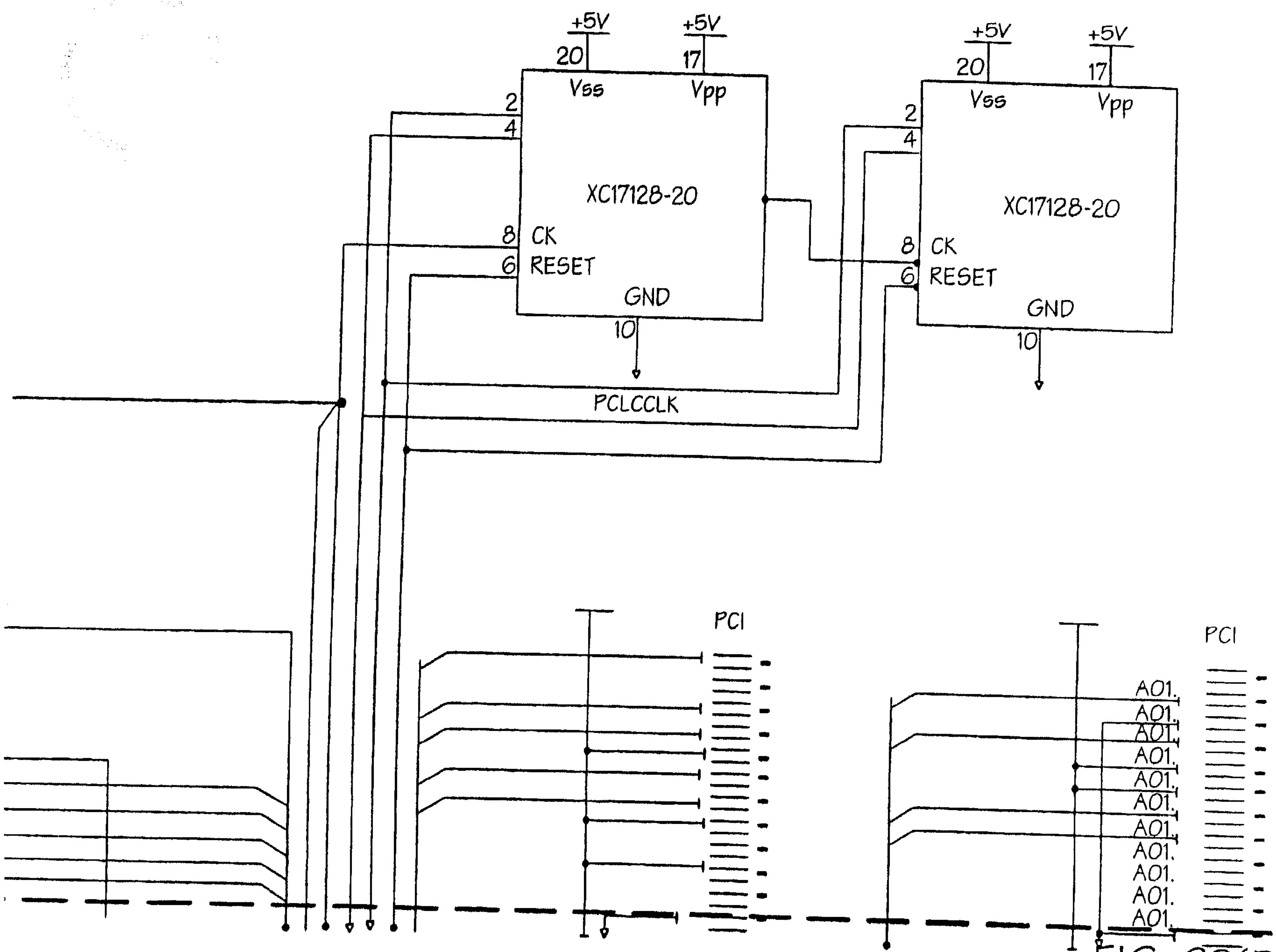

+5V
20
Vss
+5V
17
Vpp
2
4
XC17128-20
8 CK
6 RESET
GND
10
+5V
20
Vss
+5V
17
Vpp
2
4
XC17128-20
8 CK
6 RESET
GND
10
PCLCCLK
PCI
PCI
A01.
A01.
A01.
A01.
A01.
A01.
A01.
A01.
A01.
A01.
A01.

FIG. 62(D)

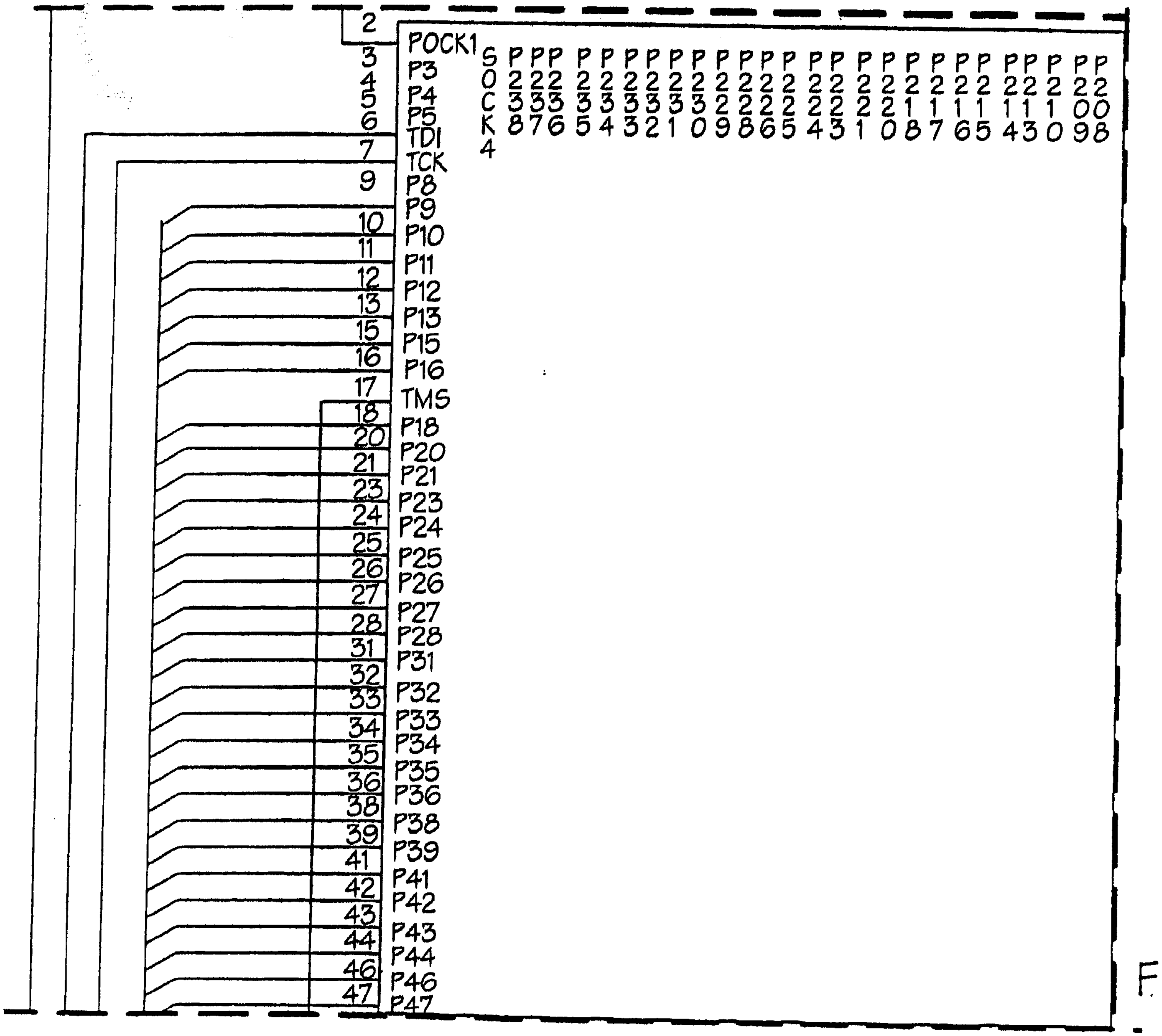
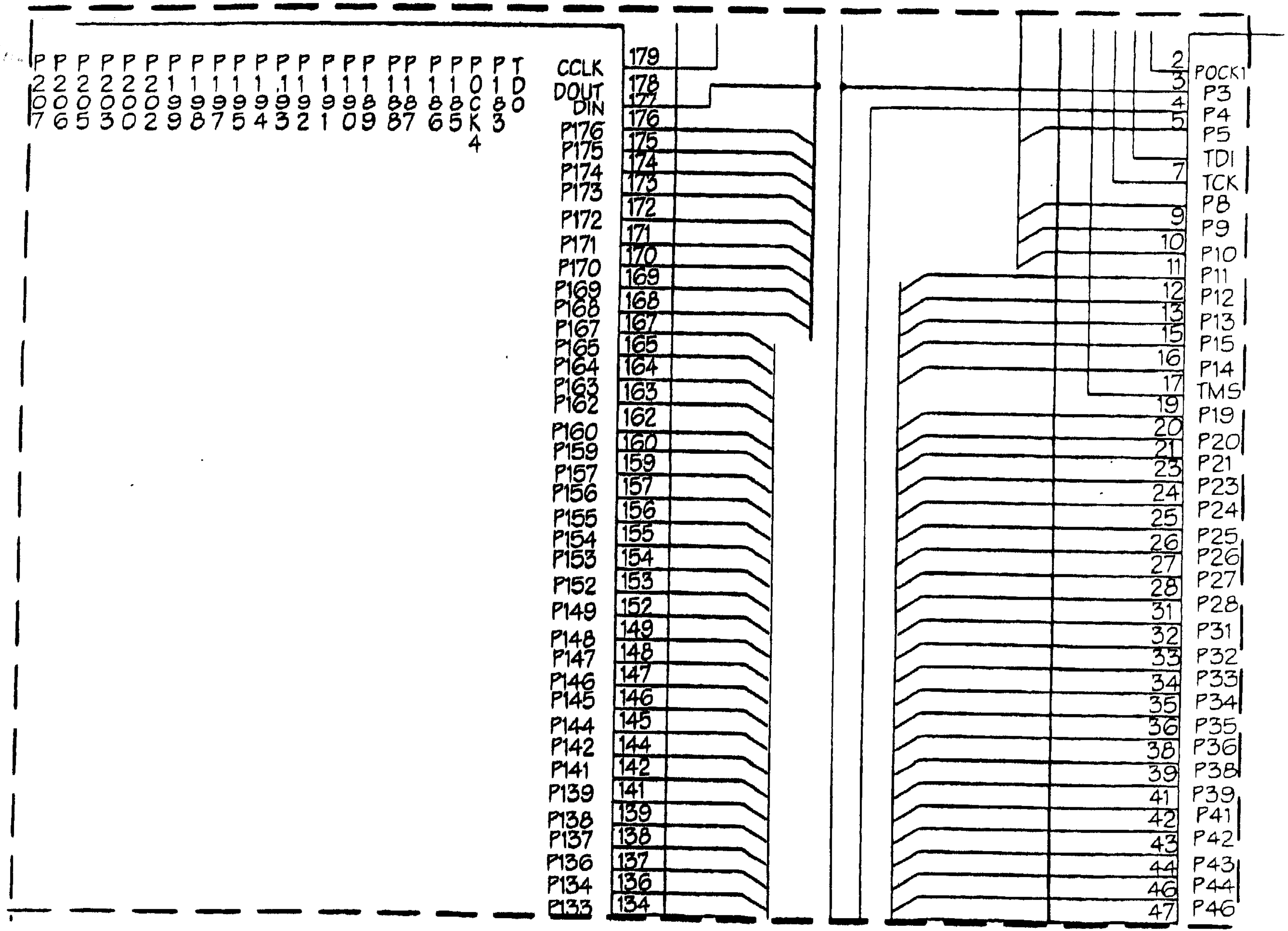

2
POCK1
3
P3
4
P4
5
P5
6
TDI
7
TCK
9
P8
P9
10
P10
11
P11
12
P12
13
P13
15
P15
16
P16
17
TMS
18
P18
20
P20
21
P21
23
P23
24
P24
25
P25
26
P26
27
P27
28
P28
31
P31
32
P32
33
P33
34
P34
35
P35
36
P36
38
P38
39
P39
41
P41
42
P42
43
P43
44
P44
46
P46
47
P47
SOCK4
P238
P237
P236
P235
P234
P233
P232
P231
P230
P229
P228
P226
P225
P224
P223
P221
P220
P218
P217
P216
P215
P214
P213
P210
P209
P208

FIG. 62(E)



P207
P206
P205
P203
P202
P199
P198
P197
P195
P194
P193
P192
P191
P190
P189
P188
P187
P186
P185
POCK4
P183
TDO
CCLK
DOUT
DIN
P176
P175
P174
P173
P172
P171
P170
P169
P168
P167
P165
P164
P163
P162
P160
P159
P157
P156
P155
P154
P153
P152
P149
P148
P147
P146
P145
P144
P142
P141
P139
P138
P137
P136
P134
P133
179
178
177
176
175
174
173
172
171
170
169
168
167
165
164
163
162
160
159
157
156
155
154
153
152
149
148
147
146
145
144
142
141
139
138
137
136
134
2
3
4
5
7
9
10
11
12
13
15
16
17
19
20
21
23
24
25
26
27
28
31
32
33
34
35
36
38
39
41
42
43
44
46
47
POCK1
P3
P4
P5
TDI
TCK
P8
P9
P10
P11
P12
P13
P15
P14
TMS
P19
P20
P21
P23
P24
P25
P26
P27
P28
P31
P32
P33
P34
P35
P36
P38
P39
P41
P42
P43
P44
P46

FIG. 62(F)

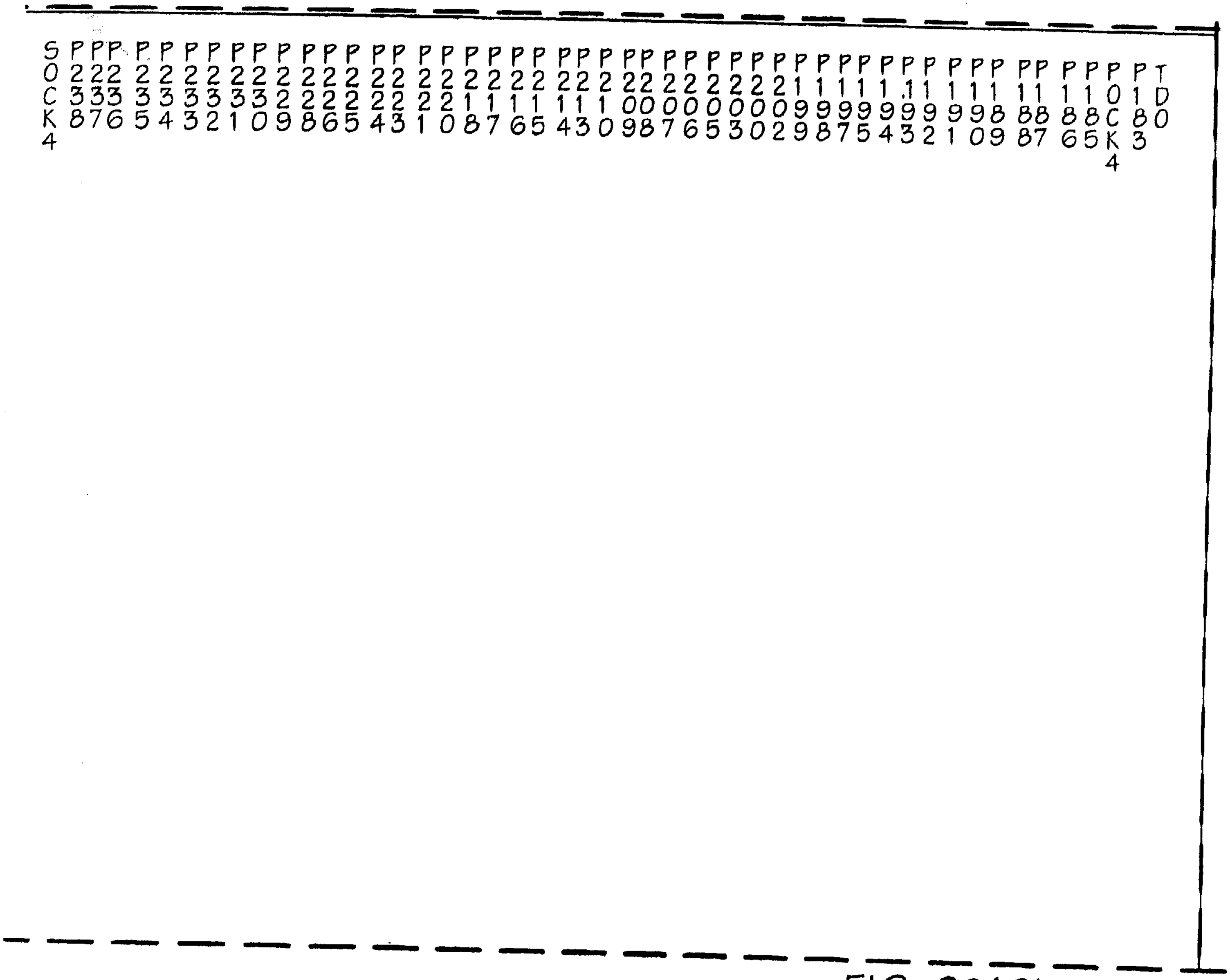

SOCK4
P238
P237
P236
P235
P234
P233
P232
P231
P230
P229
P228
P226
P225
P224
P223
P221
P220
P218
P217
P216
P215
P214
P213
P210
P209
P208
P207
P206
P205
P203
P200
P202
P199
P198
P197
P195
P194
P193
P192
P191
P190
P189
P188
P187
P186
P185
POCK4
P183
TD0

FIG. 62(G)

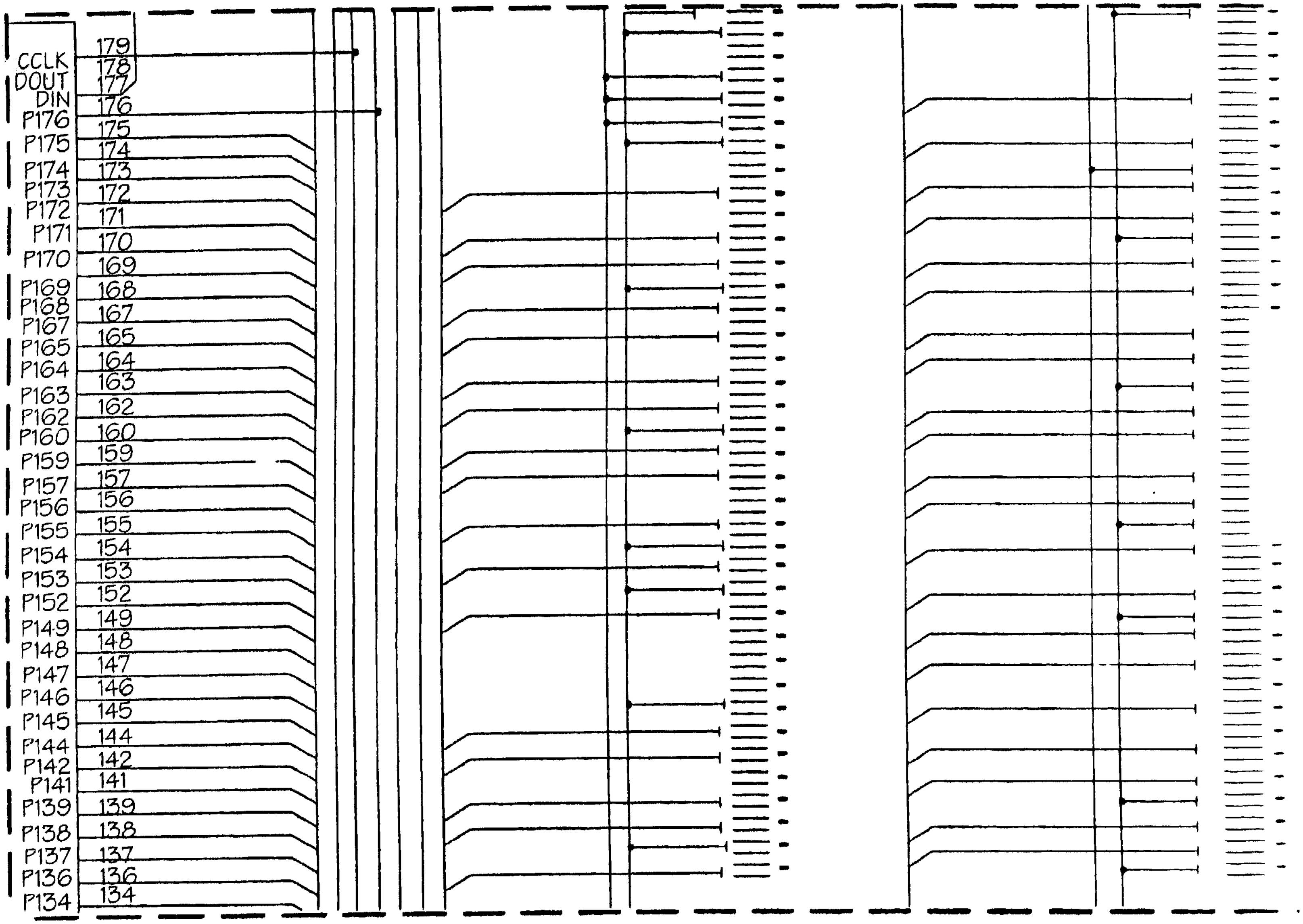
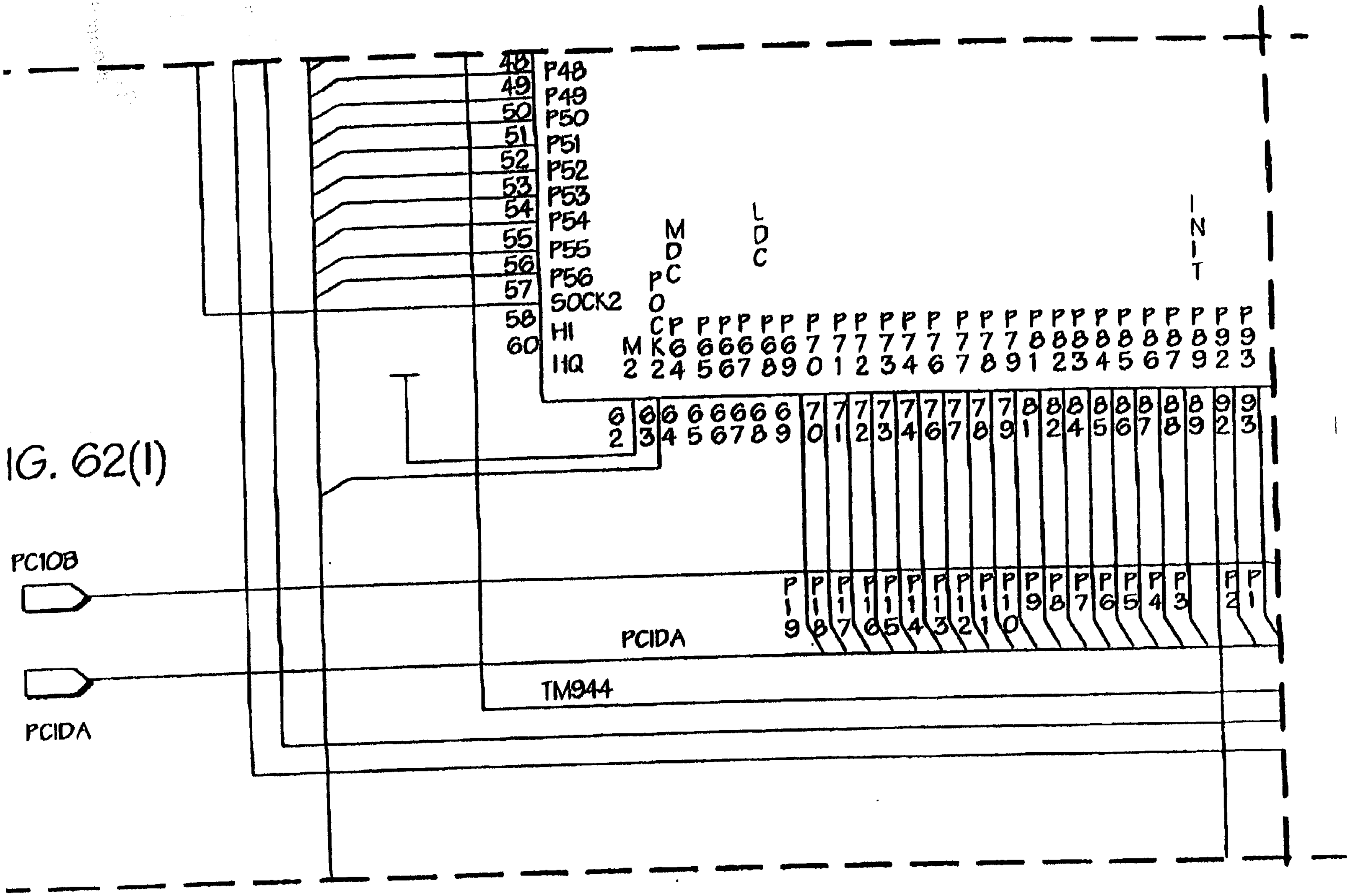

CCLK
DOUT
DIN
P176
P175
P174
P173
P172
P171
P170
P169
P168
P167
P165
P164
P163
P162
P160
P159
P157
P156
P155
P154
P153
P152
P149
P148
P147
P146
P145
P144
P142
P141
P139
P138
P137
P136
P134
179
178
177
176
175
174
173
172
171
170
169
168
167
165
164
163
162
160
159
157
156
155
154
153
152
149
148
147
146
145
144
142
141
139
138
137
136
134

FIG. 62(H)


48 P48
49 P49
50 P50
51 P51
52 P52
53 P53
54 P54
55 P55
56 P56
57 SOCK2
58 HI
60 HQ
MDC
LDC
INIT
M2
POCK
CP62
P64
P65
P66
P67
P68
P69
P70
P71
P72
P73
P74
P76
P77
P78
P79
P81
P82
P83
P84
P85
P86
P87
P89
P92
P93
62
63
64
65
66
67
68
69
70
71
72
73
74
76
77
78
79
81
82
84
85
86
87
88
89
92
93
P19
P18
P17
P16
P15
P14
P13
P12
P11
P10
P9
P8
P7
P6
P5
P4
P3
P2
P1
PC10B
PCIDA
PCIDA
TM944

IG. 62(I)

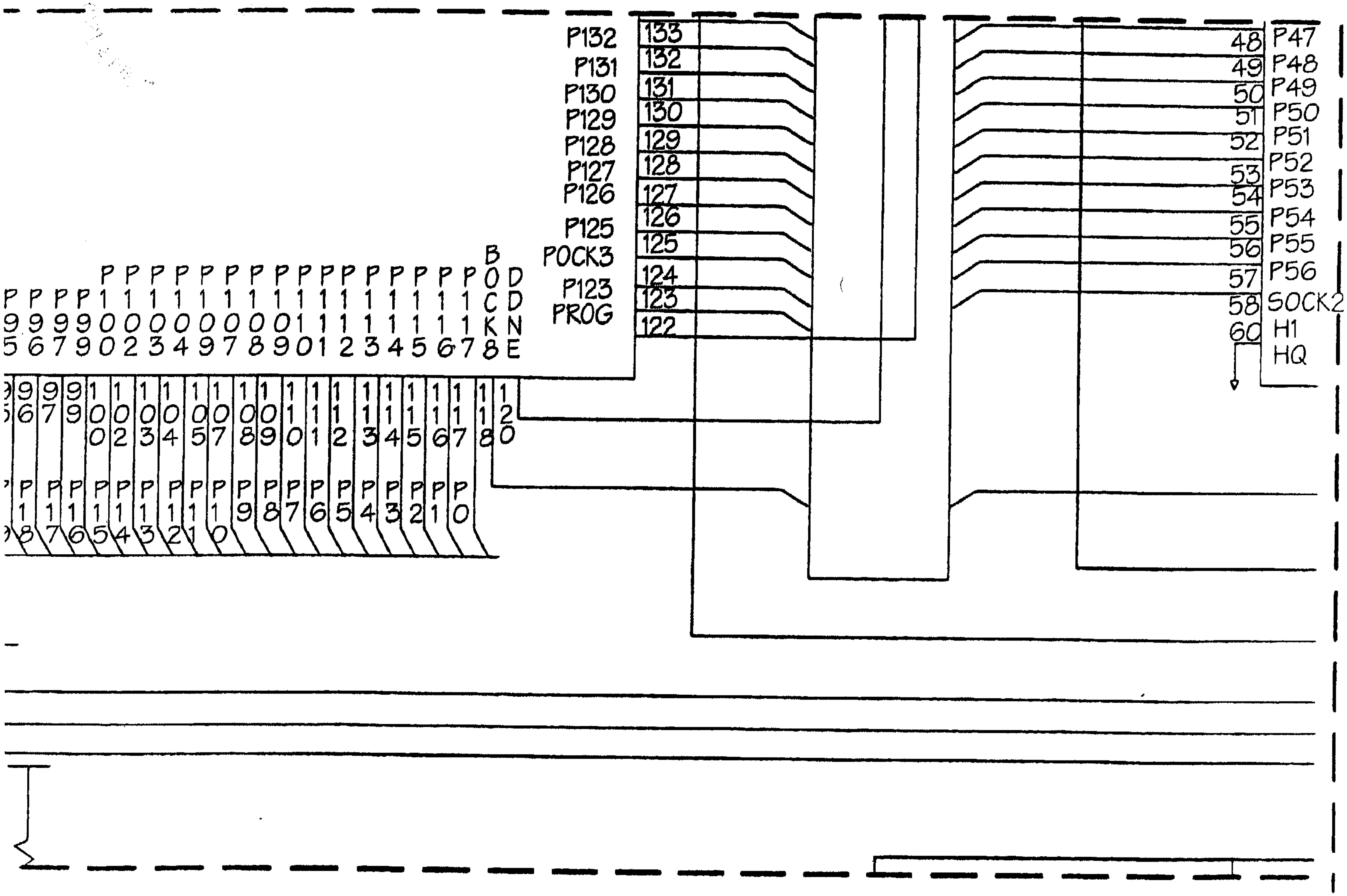

P132
P131
P130
P129
P128
P127
P126
P125
POCK3
P123
PROG
133
132
131
130
129
128
127
126
125
124
123
122
P95
P96
P97
P99
P100
P102
P103
P104
P109
P107
P108
P109
P110
P111
P112
P113
P114
P115
P116
P117
BOCK8
DDNE
95
96
97
99
100
102
103
104
105
107
108
109
110
111
112
113
114
115
116
117
118
120
P118
P117
P116
P115
P114
P113
P112
P111
P110
P9
P8
P7
P6
P5
P4
P3
P2
P1
P0
48
49
50
51
52
53
54
55
56
57
58
60
P47
P48
P49
P50
P51
P52
P53
P54
P55
P56
SOCK2
H1
HQ

FIG. 62(J)

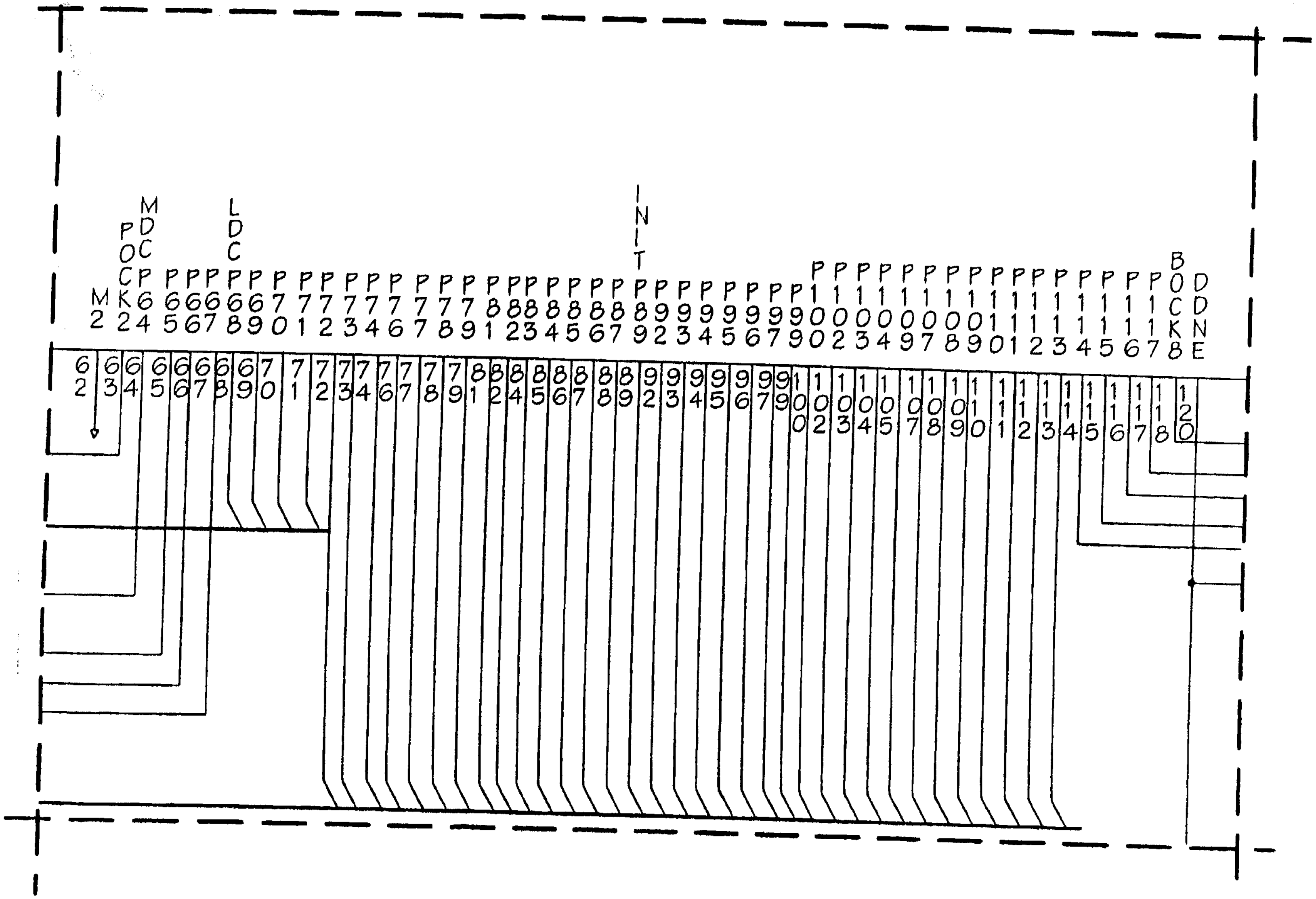

M2
POCK2
MDCP64
P65
P66
P67
LDCP68
P69
P70
P71
P72
P73
P74
P76
P77
P78
P79
P81
P82
P83
P84
P85
P86
P87
INITP89
P92
P93
P94
P95
P96
P97
P99
P100
P102
P103
P104
P109
P107
P108
P109
P110
P111
P112
P113
P114
P115
P116
P117
BOCK8
DDNE
62
63
64
65
66
67
68
69
70
71
72
73
74
76
77
78
79
81
82
84
85
86
87
88
89
92
93
94
95
96
97
99
100
102
103
104
105
107
108
109
110
111
112
113
114
115
116
117
118
120

FIG. 62(K)

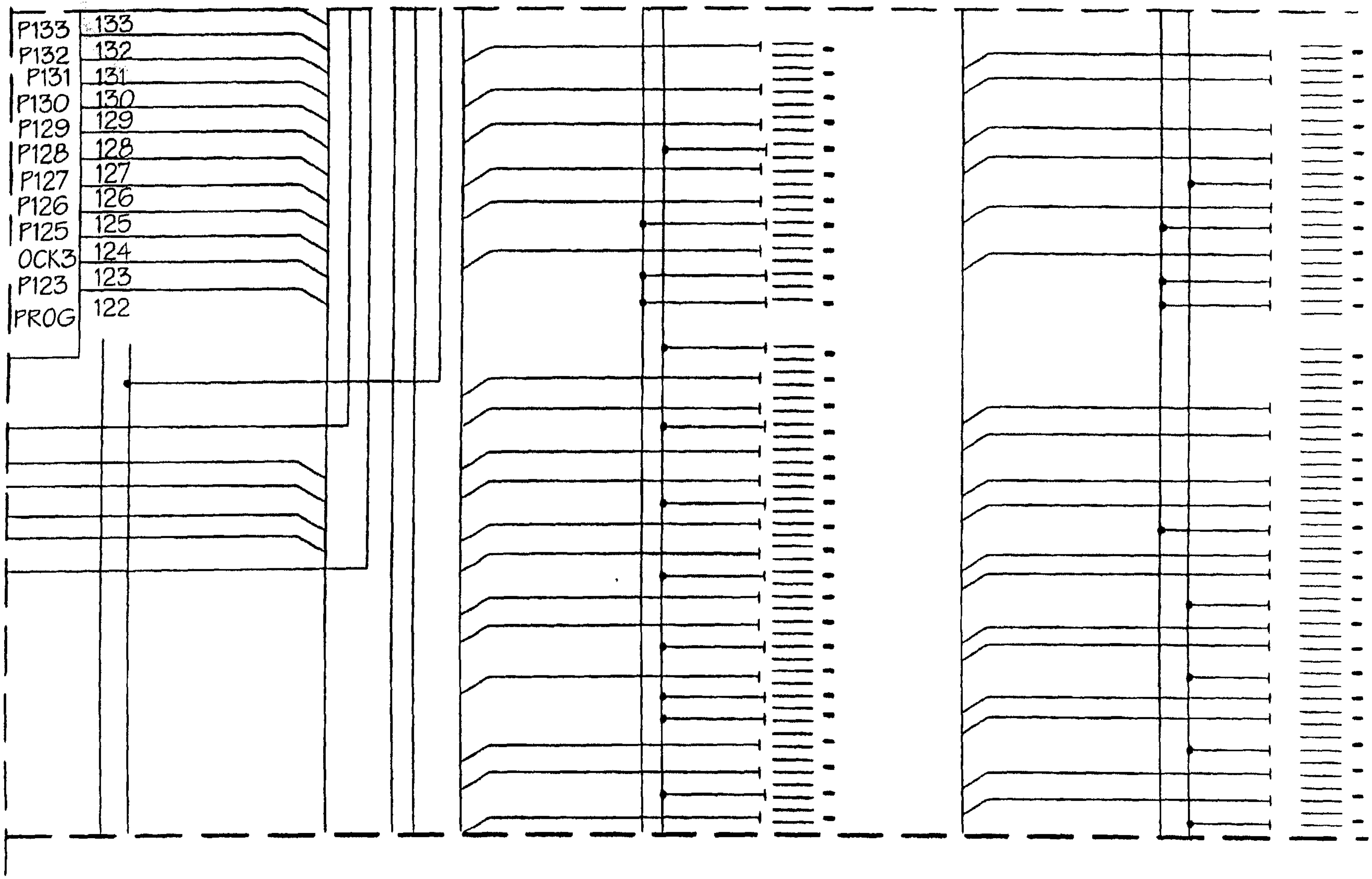

P133
P132
P131
P130
P129
P128
P127
P126
P125
OCK3
P123
PROG
133
132
131
130
129
128
127
126
125
124
123
122

FIG. 62(L)

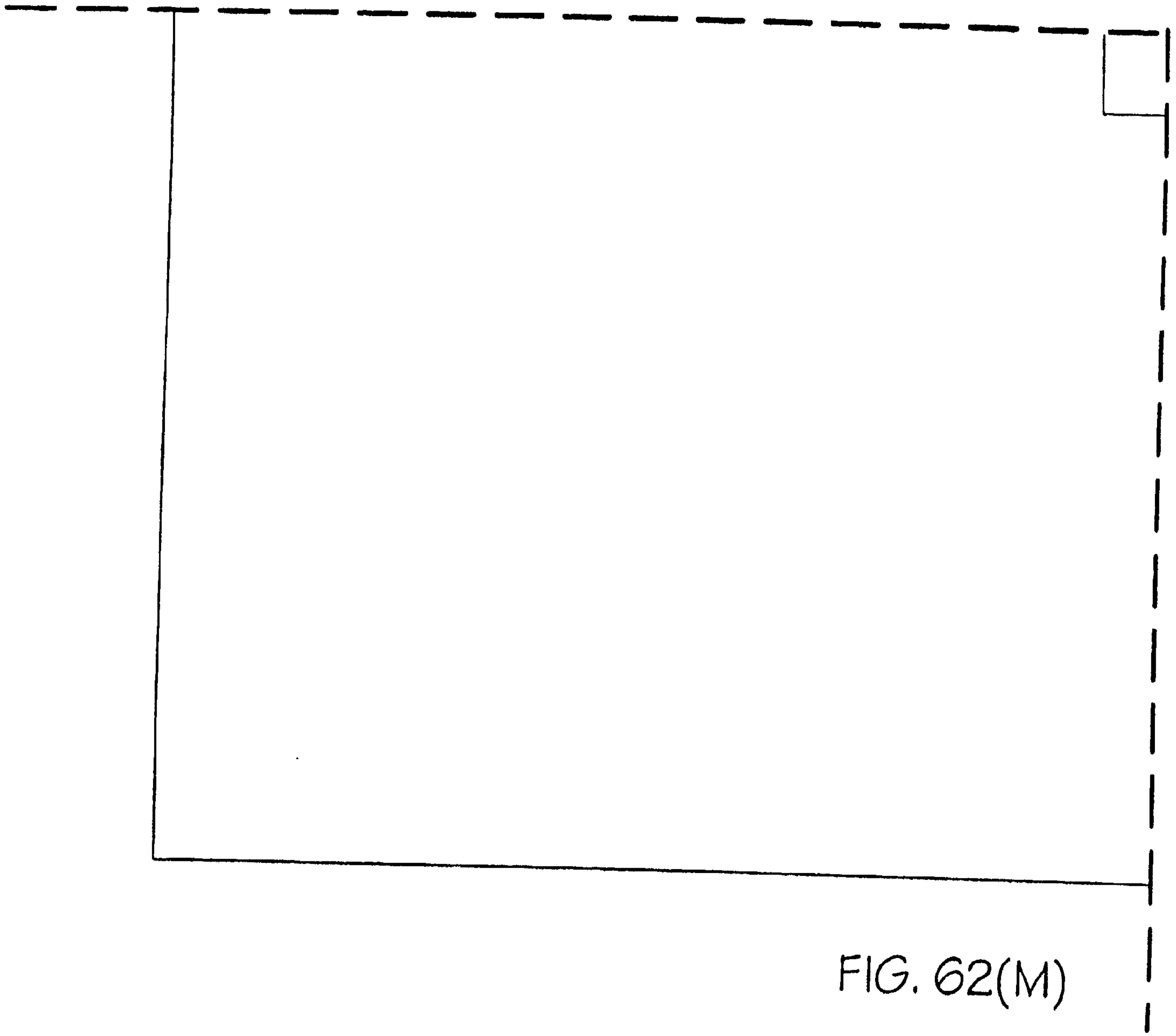


FIG. 62(M)

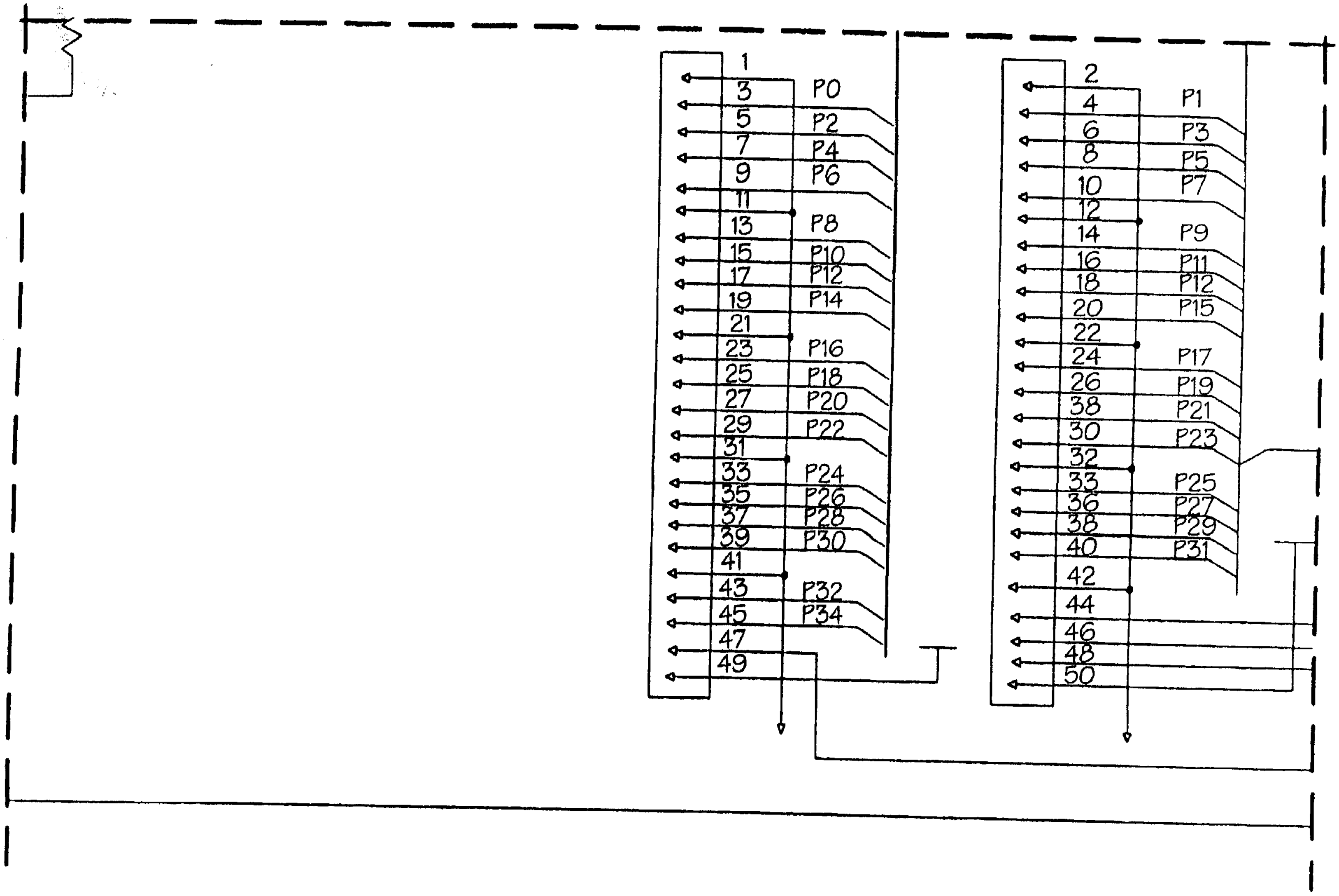

1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
P0
P2
P4
P6
P8
P10
P12
P14
P16
P18
P20
P22
P24
P26
P28
P30
P32
P34
2
4
6
8
10
12
14
16
18
20
22
24
26
38
30
32
33
36
38
40
42
44
46
48
50
P1
P3
P5
P7
P9
P11
P12
P15
P17
P19
P21
P23
P25
P27
P29
P31

FIG. 62(N)

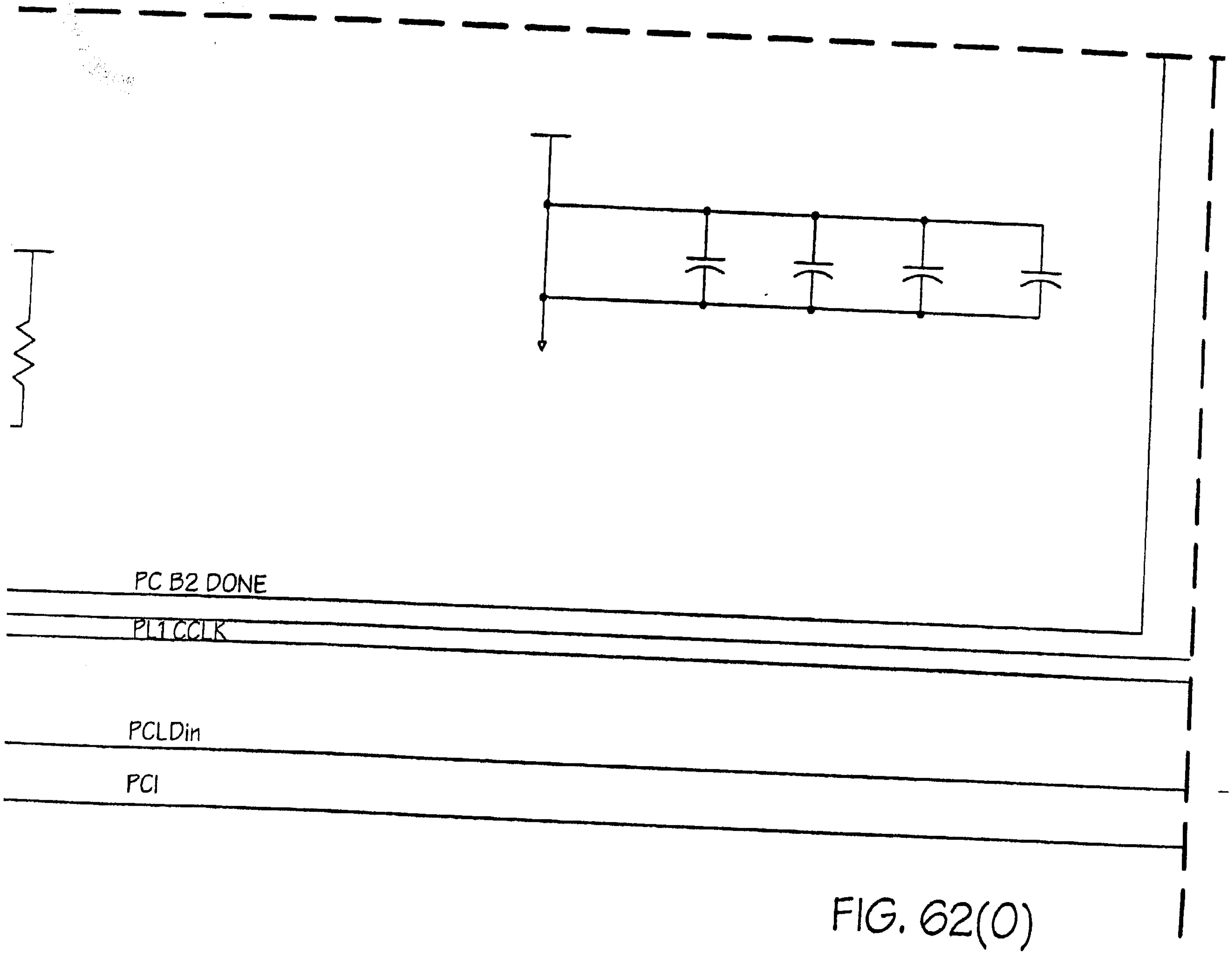


FIG. 62(0)

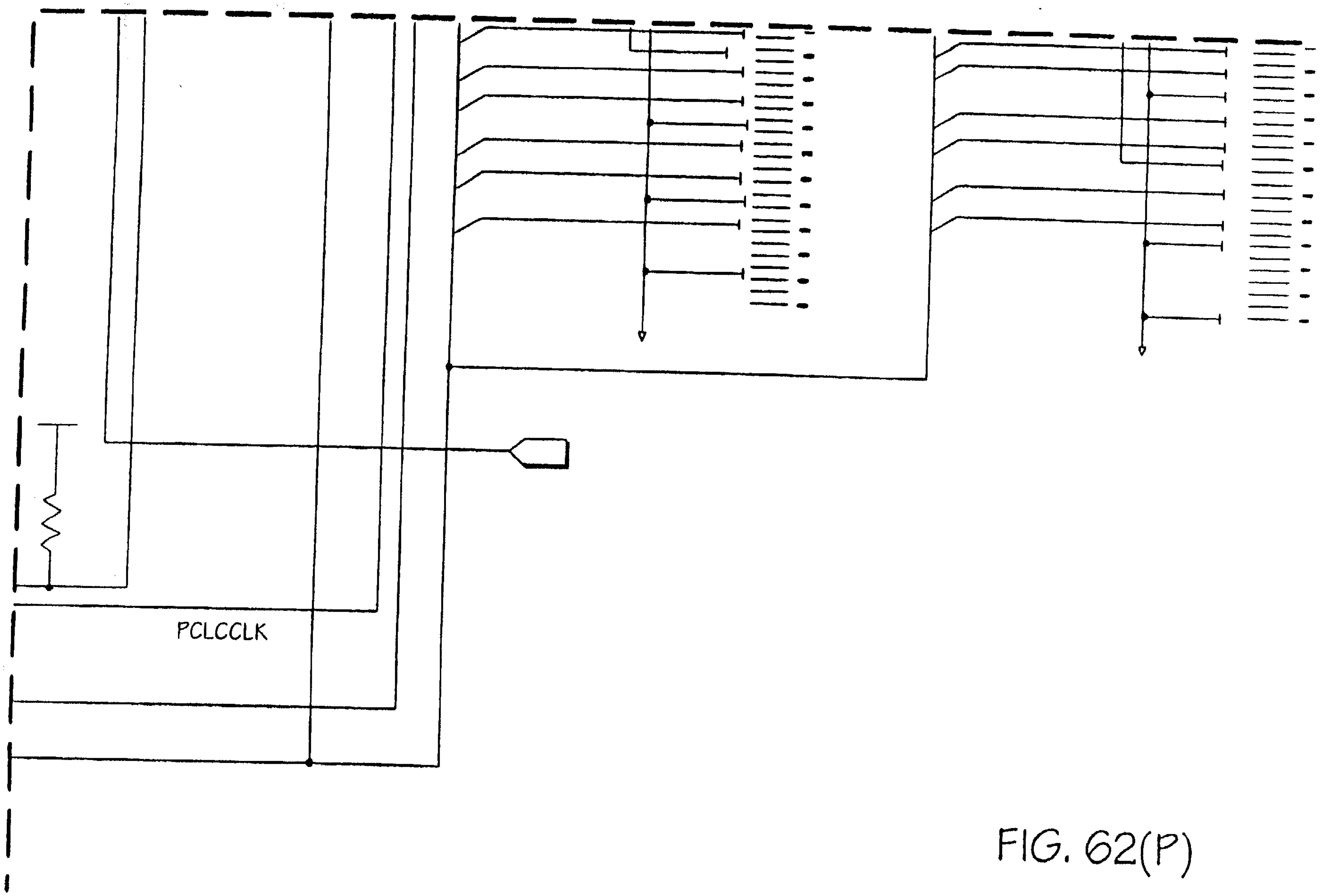


FIG. 62(P)

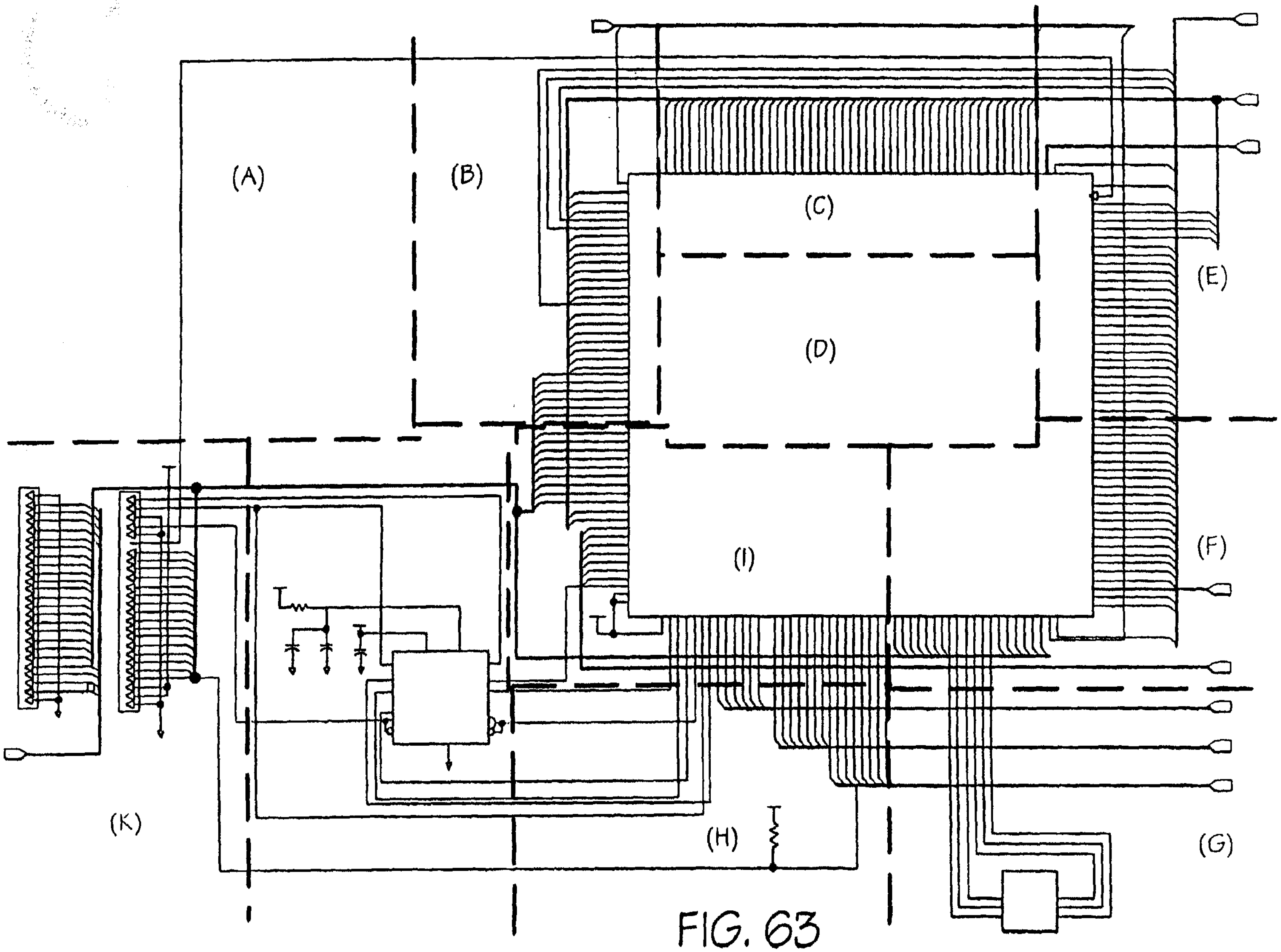


FIG. 63

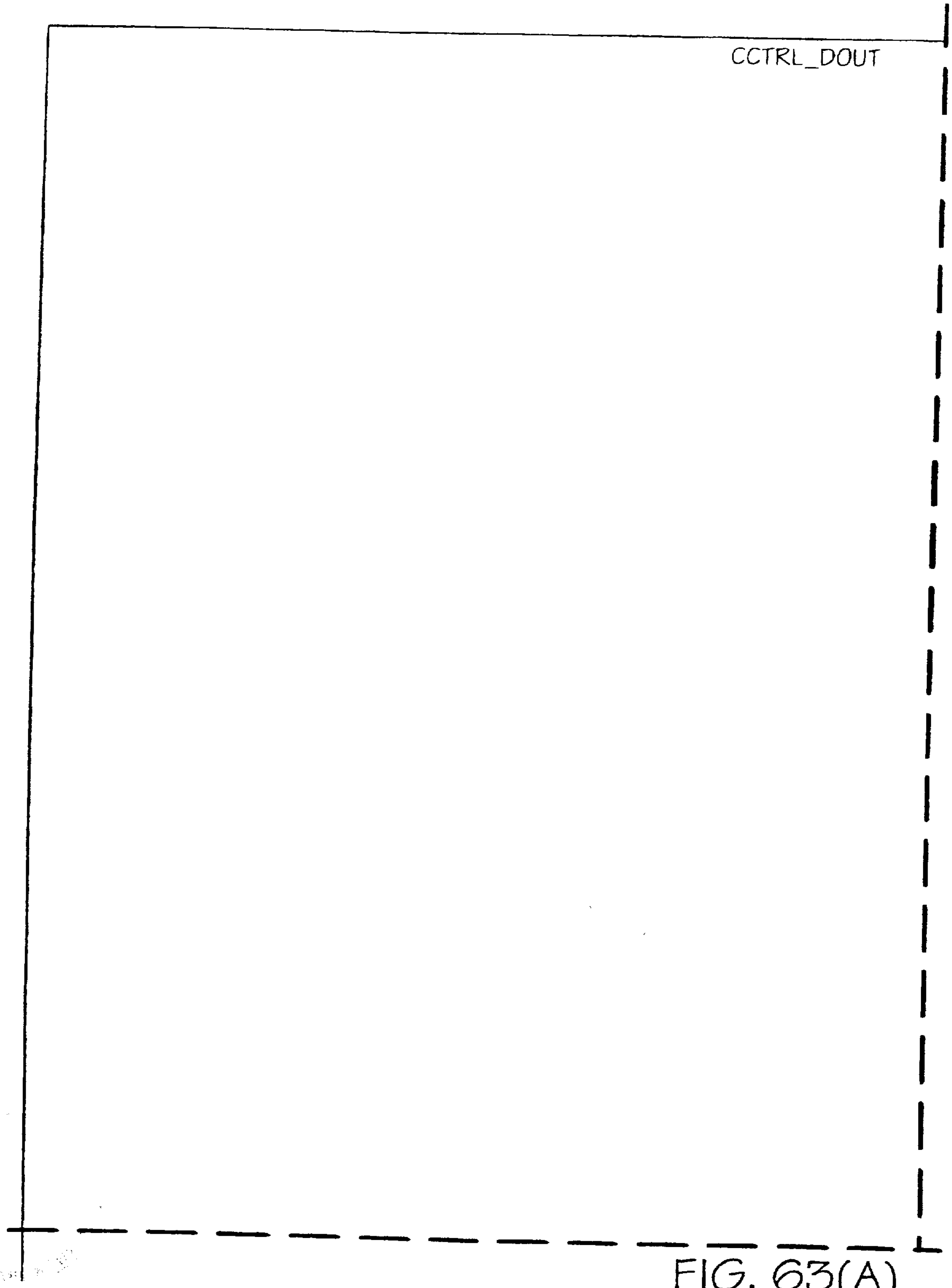


FIG. 63(A)

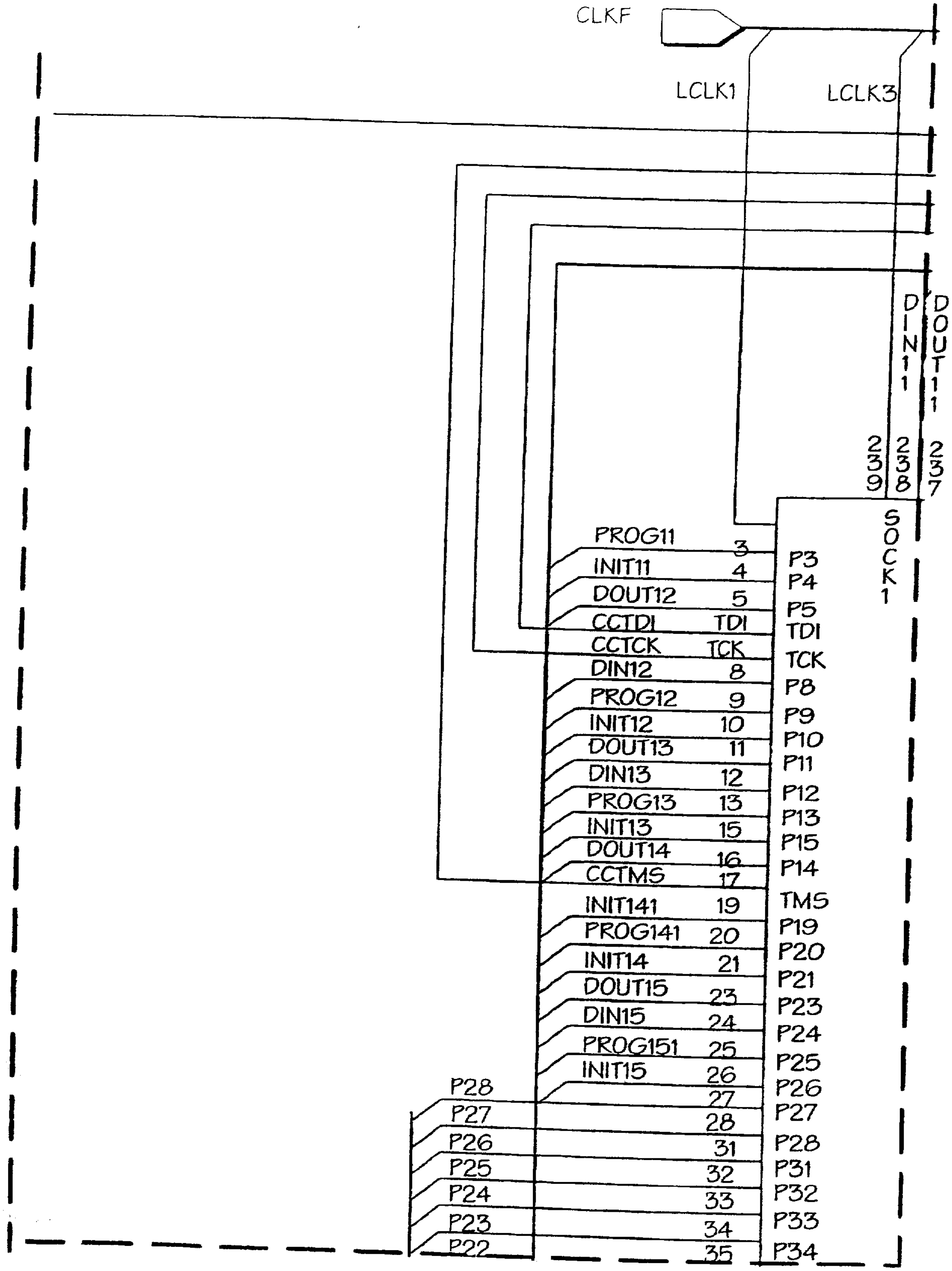

CLKF
LCLK1
LCLK3
DIN11
DOUT11
239
238
237
SOCK1
PROG11
INIT11
DOUT12
CCTDI
CCTCK
DIN12
PROG12
INIT12
DOUT13
DIN13
PROG13
INIT13
DOUT14
CCTMS
INIT141
PROG141
INIT14
DOUT15
DIN15
PROG151
INIT15
P28
P27
P26
P25
P24
P23
P22
3
4
5
TDI
TCK
8
9
10
11
12
13
15
16
17
19
20
21
23
24
25
26
27
28
31
32
33
34
35
P3
P4
P5
TDI
TCK
P8
P9
P10
P11
P12
P13
P15
P14
TMS
P19
P20
P21
P23
P24
P25
P26
P27
P28
P31
P32
P33
P34

FIG. 63(B)

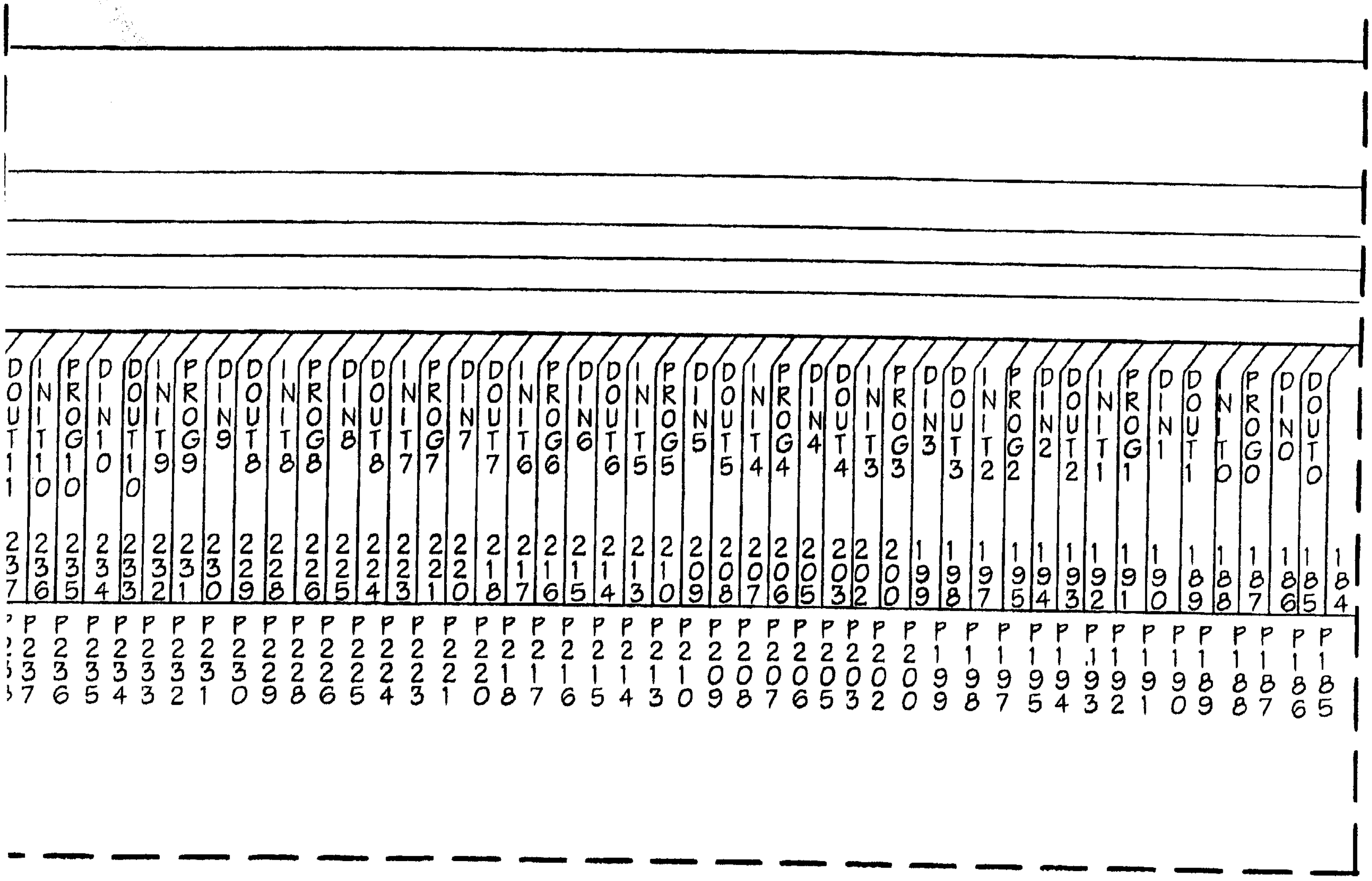

DOUT11
INIT10
PROG10
DIN10
DOUT10
INIT9
PROG9
DIN9
DOUT8
INIT8
PROG8
DIN8
DOUT8
INIT7
PROG7
DIN7
DOUT7
INIT6
PROG6
DIN6
DOUT6
INIT5
PROG5
DIN5
DOUT5
INIT4
PROG4
DIN4
DOUT4
INIT3
PROG3
DIN3
DOUT3
INIT2
PROG2
DIN2
DOUT2
INIT1
PROG1
DIN1
DOUT1
INIT0
PROG0
DIN0
DOUT0
237
236
235
234
233
232
231
230
229
228
226
225
224
223
221
220
218
217
216
215
214
213
210
209
208
207
206
205
203
202
200
199
198
197
195
194
193
192
191
190
189
188
187
186
185
184
P237
P236
P235
P234
P233
P232
P231
P230
P229
P228
P226
P225
P224
P223
P221
P220
P218
P217
P216
P215
P214
P213
P210
P209
P208
P207
P206
P205
P203
P202
P200
P199
P198
P197
P195
P194
P193
P192
P191
P190
P189
P188
P187
P186
P185

FIG. 63(C)

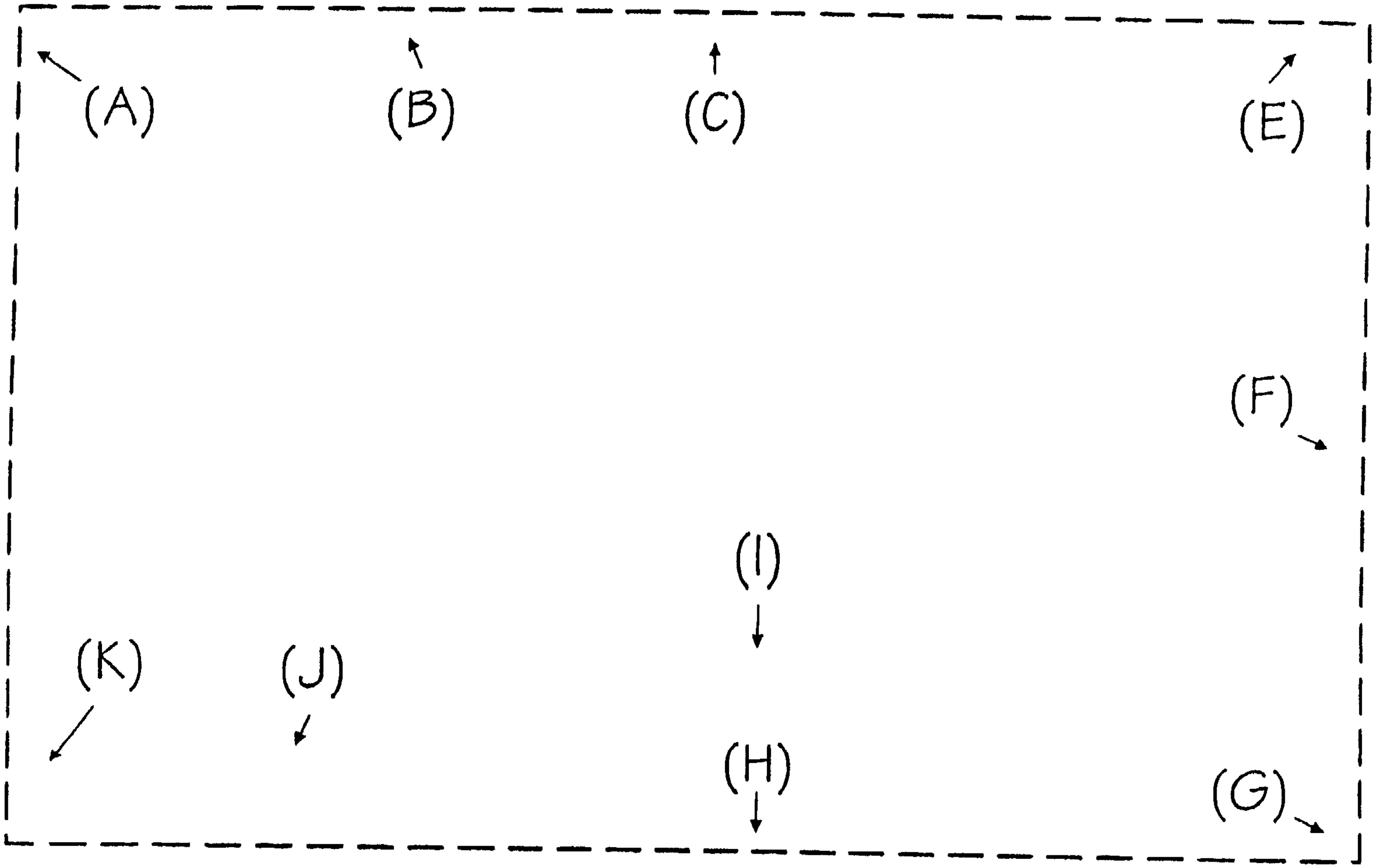


FIG. 63(D)

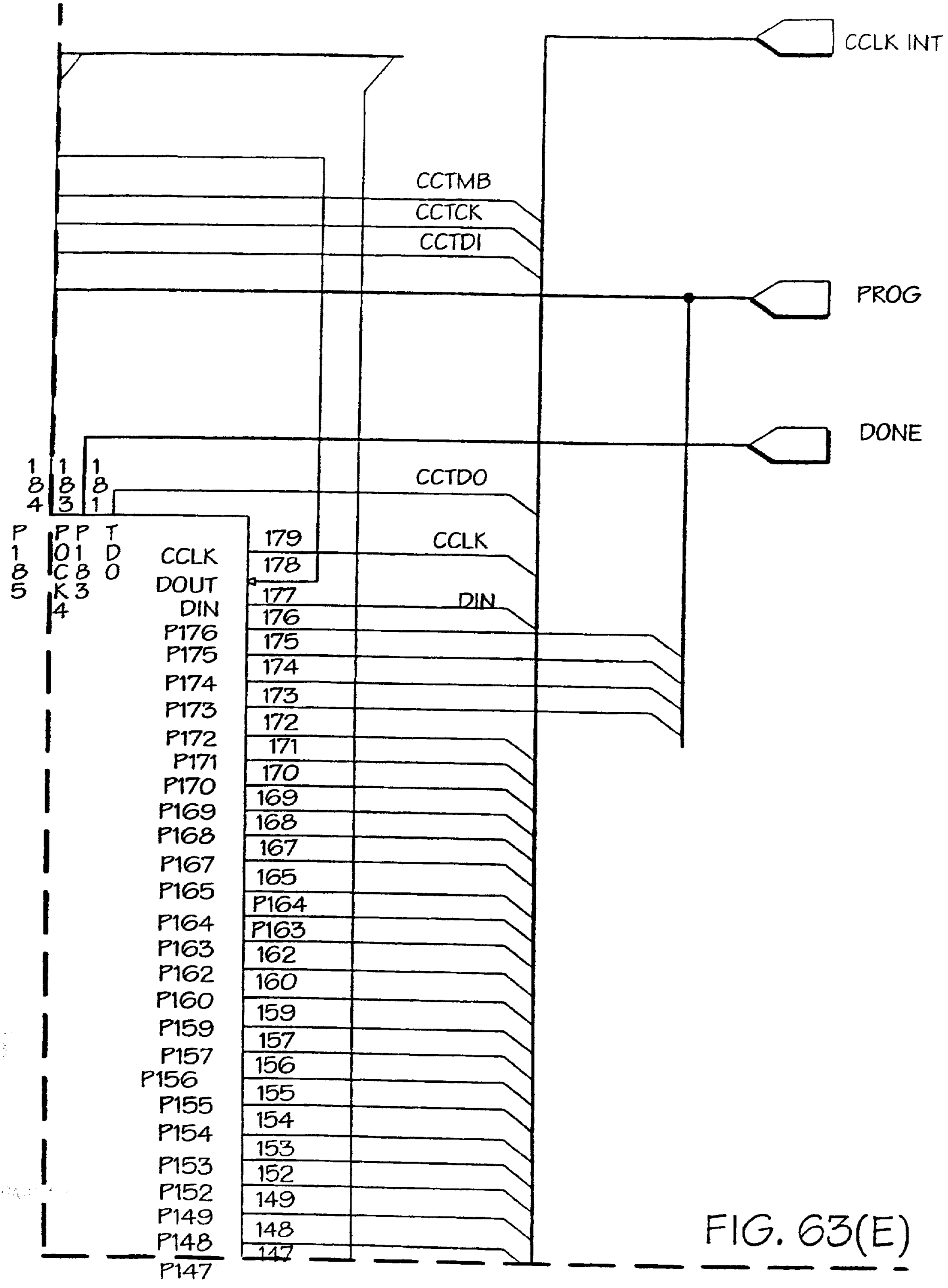

CCLK INT
CCTMB
CCTCK
CCTDI
PROG
DONE
CCTDO
CCLK
DIN
184
183
181
P185
P0CK4
P183
TDO
CCLK
DOUT
DIN
P176
P175
P174
P173
P172
P171
P170
P169
P168
P167
P165
P164
P163
P162
P160
P159
P157
P156
P155
P154
P153
P152
P149
P148
P147
179
178
177
176
175
174
173
172
171
170
169
168
167
165
P164
P163
162
160
159
157
156
155
154
153
152
149
148
147

FIG. 63(E)

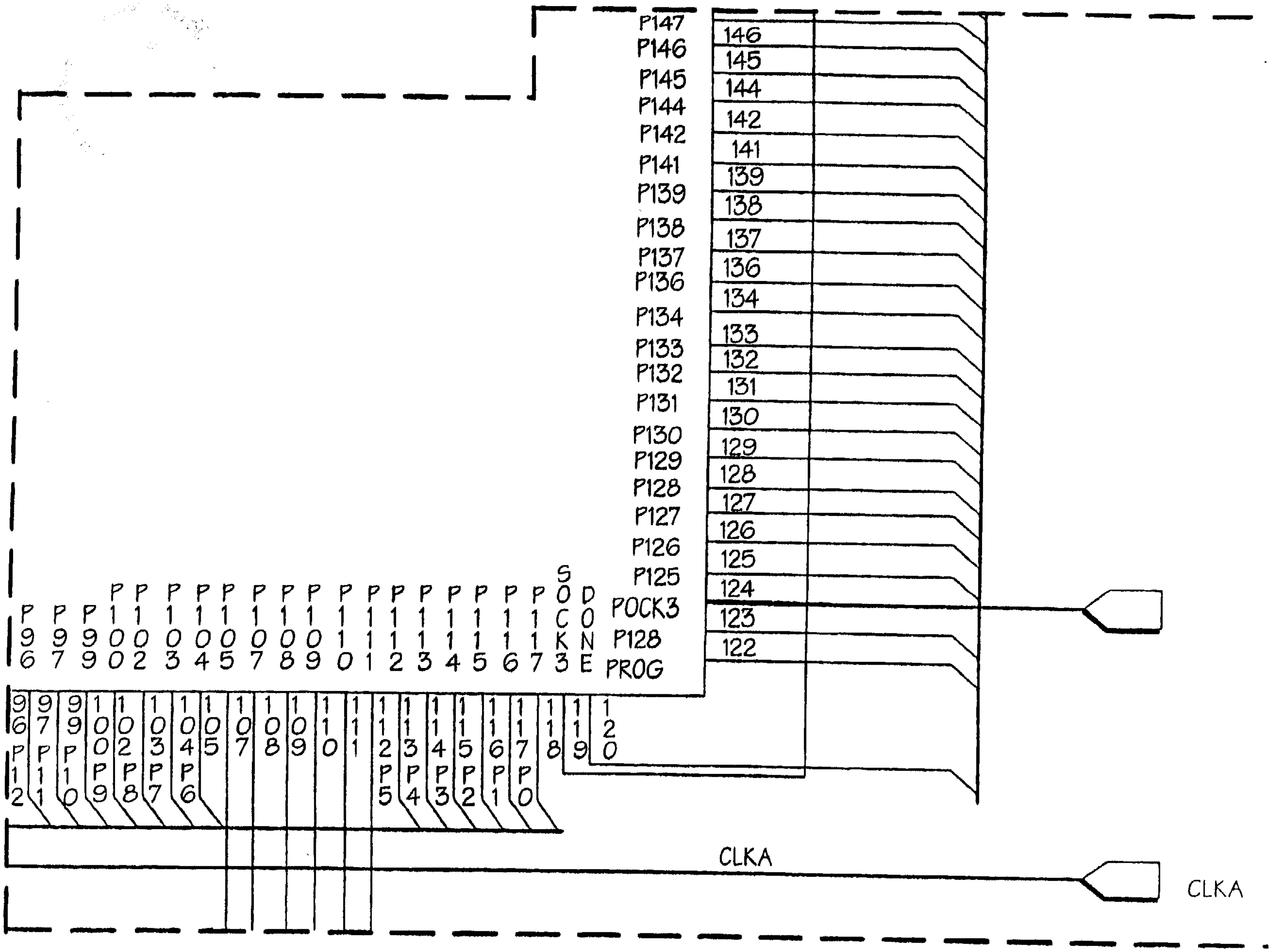

P147
P146
P145
P144
P142
P141
P139
P138
P137
P136
P134
P133
P132
P131
P130
P129
P128
P127
P126
P125
POCK3
P128
PROG
146
145
144
142
141
139
138
137
136
134
133
132
131
130
129
128
127
126
125
124
123
122
P96
P97
P99
P100
P102
P103
P104
P105
P107
P108
P109
P110
P111
P112
P113
P114
P115
P116
P117
SOCK3
DONE
96
97
99
100
102
103
104
105
107
108
109
110
111
112
113
114
115
116
117
118
119
120
P12
P11
P10
P9
P8
P7
P6
P5
P4
P3
P2
P1
P0
CLKA
CLKA

FIG. 63(F)

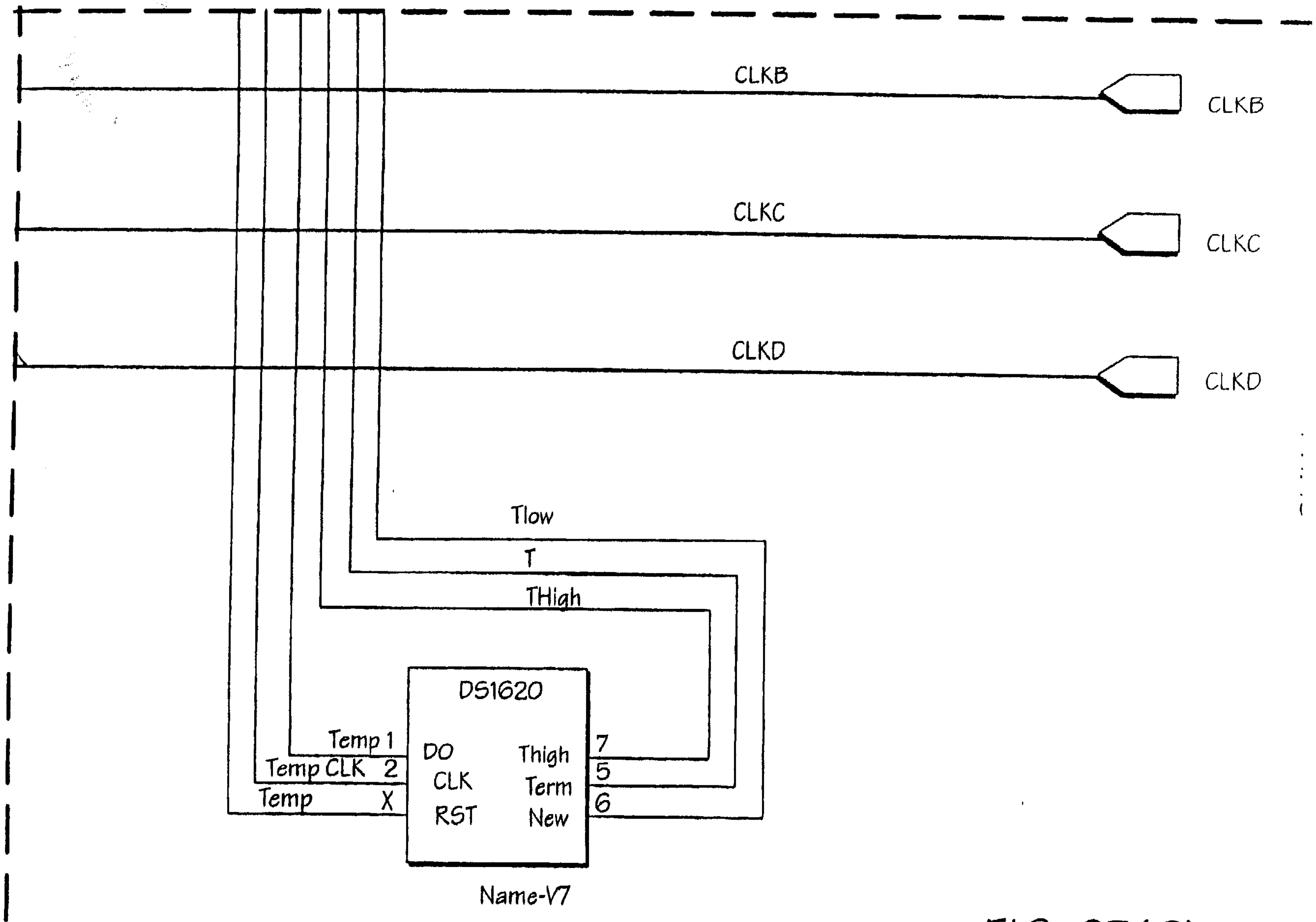
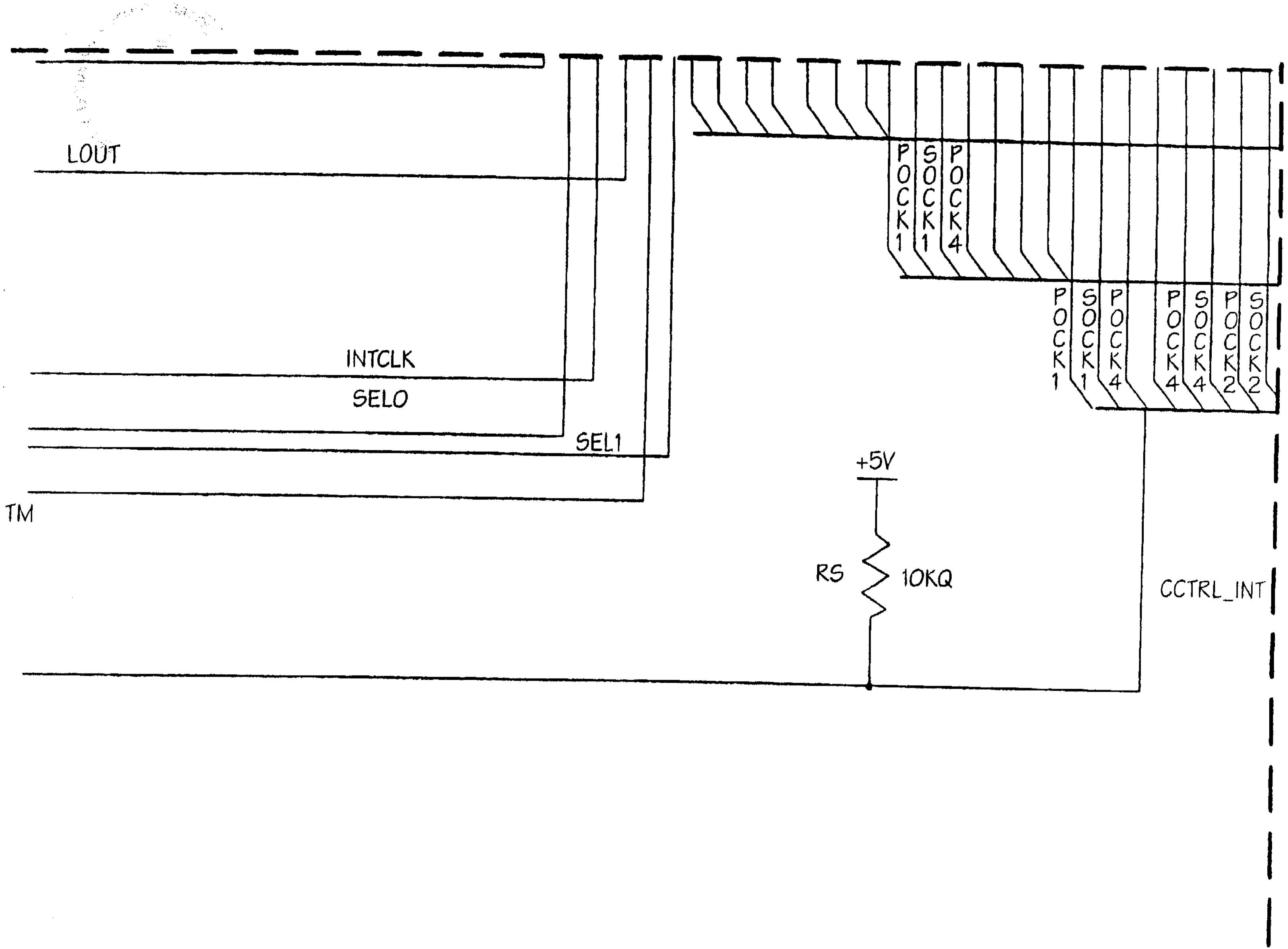

CLKB
CLKB
CLKC
CLKC
CLKD
CLKD
Tlow
T
THigh
DS1620
Temp 1
Temp CLK
Temp
2
X
DO
CLK
RST
Thigh
Term
New
7
5
6
Name-V7

FIG. 63(G)



LOUT
INTCLK
SELO
SEL1
TM
POCK1
SOCK1
POCK4
POCK1
SOCK1
POCK4
POCK4
SOCK4
POCK2
SOCK2
+5V
RS
10KQ
CCTRL_INT

FIG. 63(H)

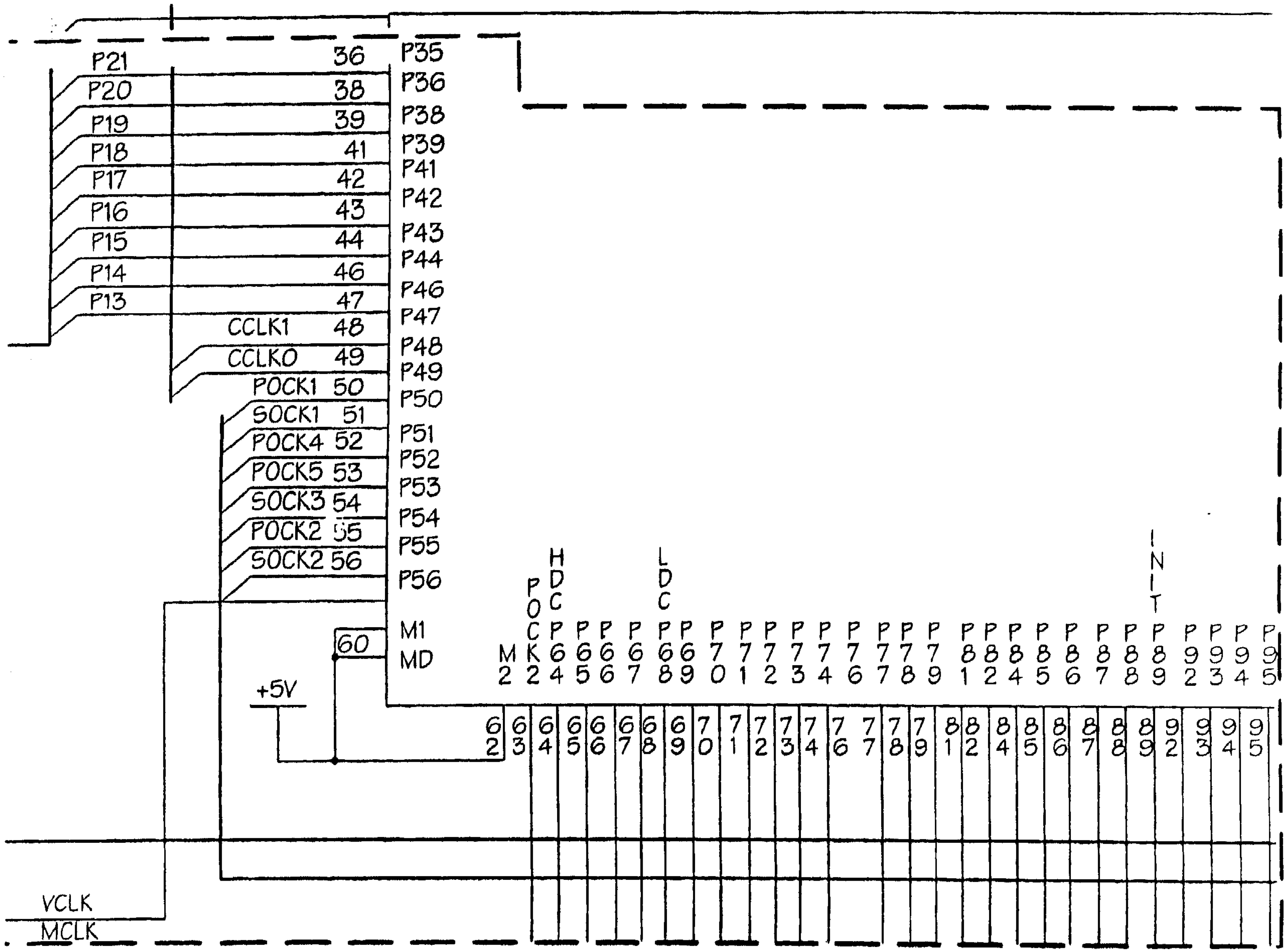
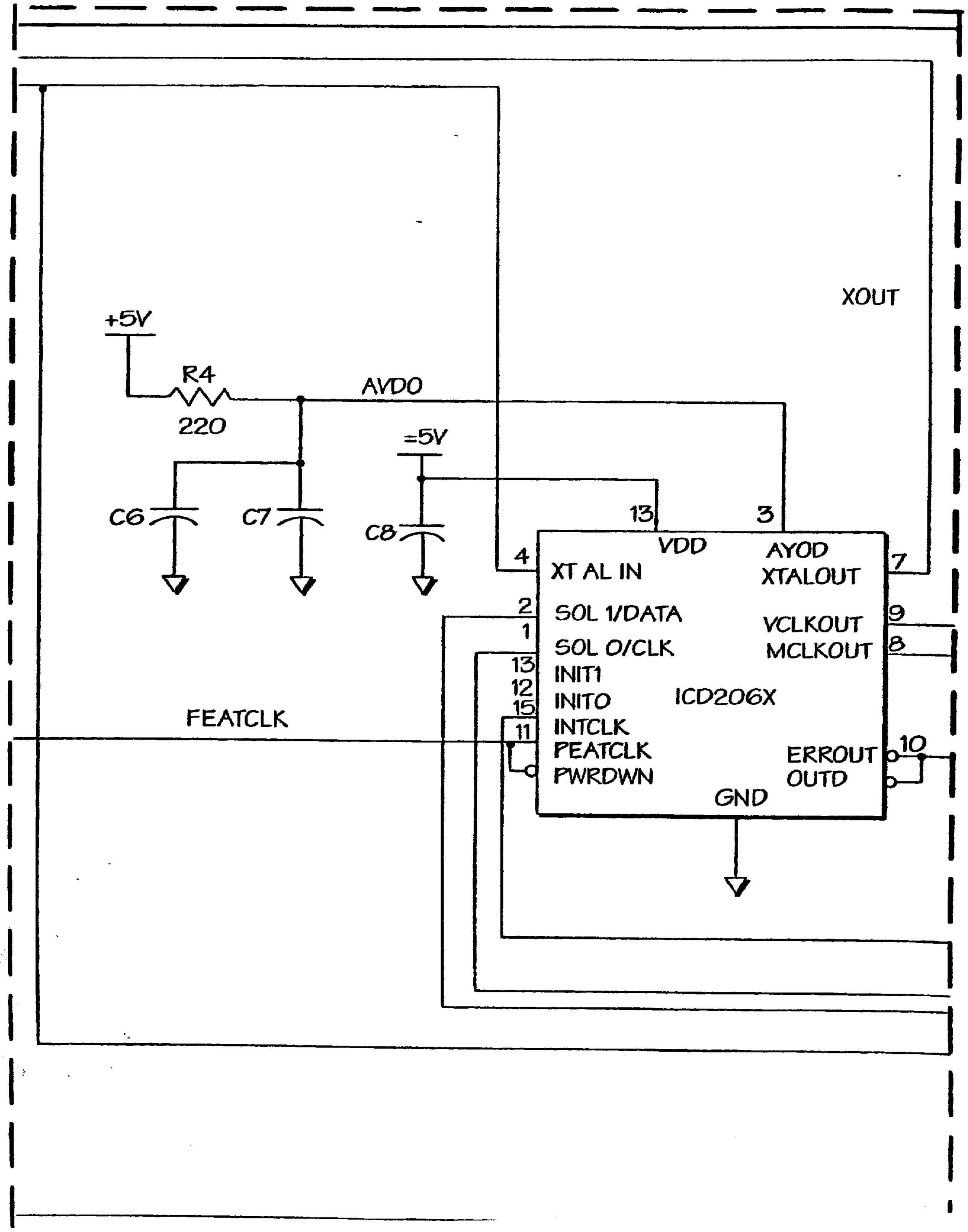

P21
P20
P19
P18
P17
P16
P15
P14
P13
36
38
39
41
42
43
44
46
47
CCLK1 48
CCLKO 49
POCK1 50
SOCK1 51
POCK4 52
POCK5 53
SOCK3 54
POCK2 55
SOCK2 56
P35
P36
P38
P39
P41
P42
P43
P44
P46
P47
P48
P49
P50
P51
P52
P53
P54
P55
P56
M1
MD
60
+5V
VCLK
MCLK
M2
POCK2
HDC P64
P65
P66
P67
LDC P68
P69
P70
P71
P72
P73
P74
P76
P77
P78
P79
P81
P82
P84
P85
P86
P87
P88
INIT P89
P92
P93
P94
P95
62
63
64
65
66
67
68
69
70
71
72
73
74
76
77
78
79
81
82
84
85
86
87
88
89
92
93
94
95

FIG. 63(I)


XOUT
+5V
R4
220
AVDO
=5V
C6
C7
C8
13
3
4
VDD
AYOD
XT AL IN
XTALOUT
7
2
SOL 1/DATA
VCLKOUT
9
1
SOL O/CLK
MCLKOUT
8
13
INIT1
12
INITO
ICD206X
15
INTCLK
FEATCLK
11
PEATCLK
ERROUT
10
PWRDWN
OUTD
GND

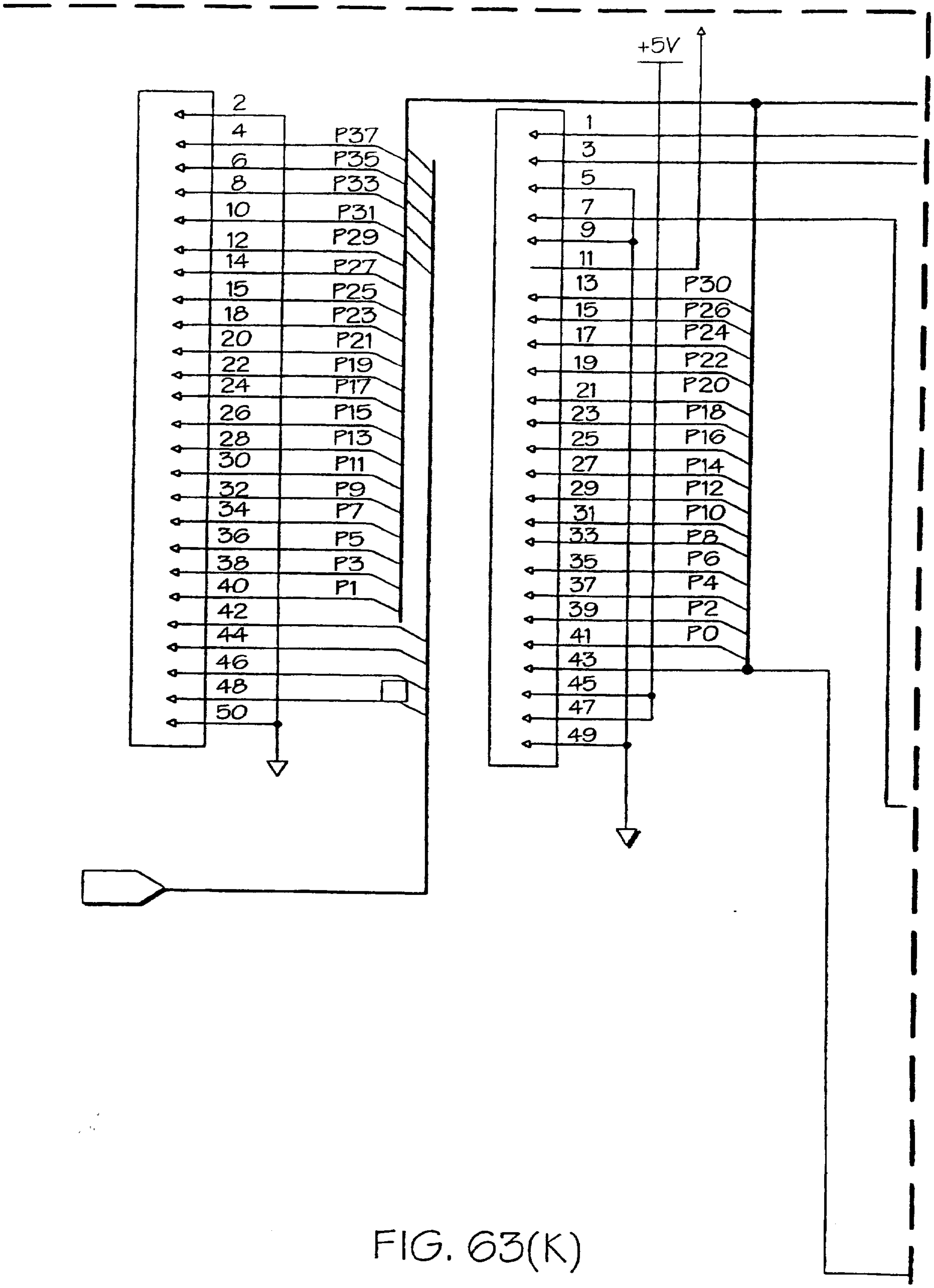
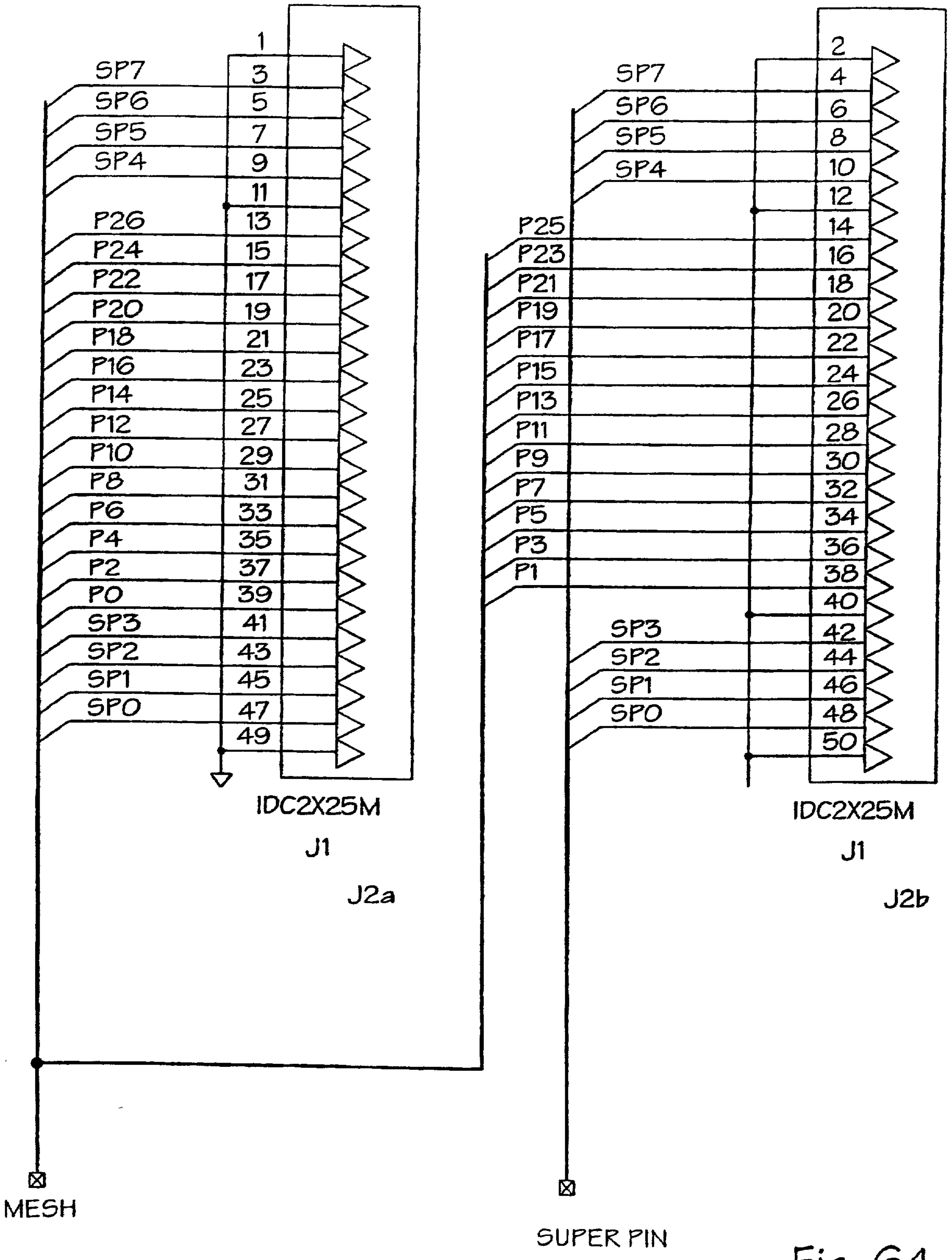
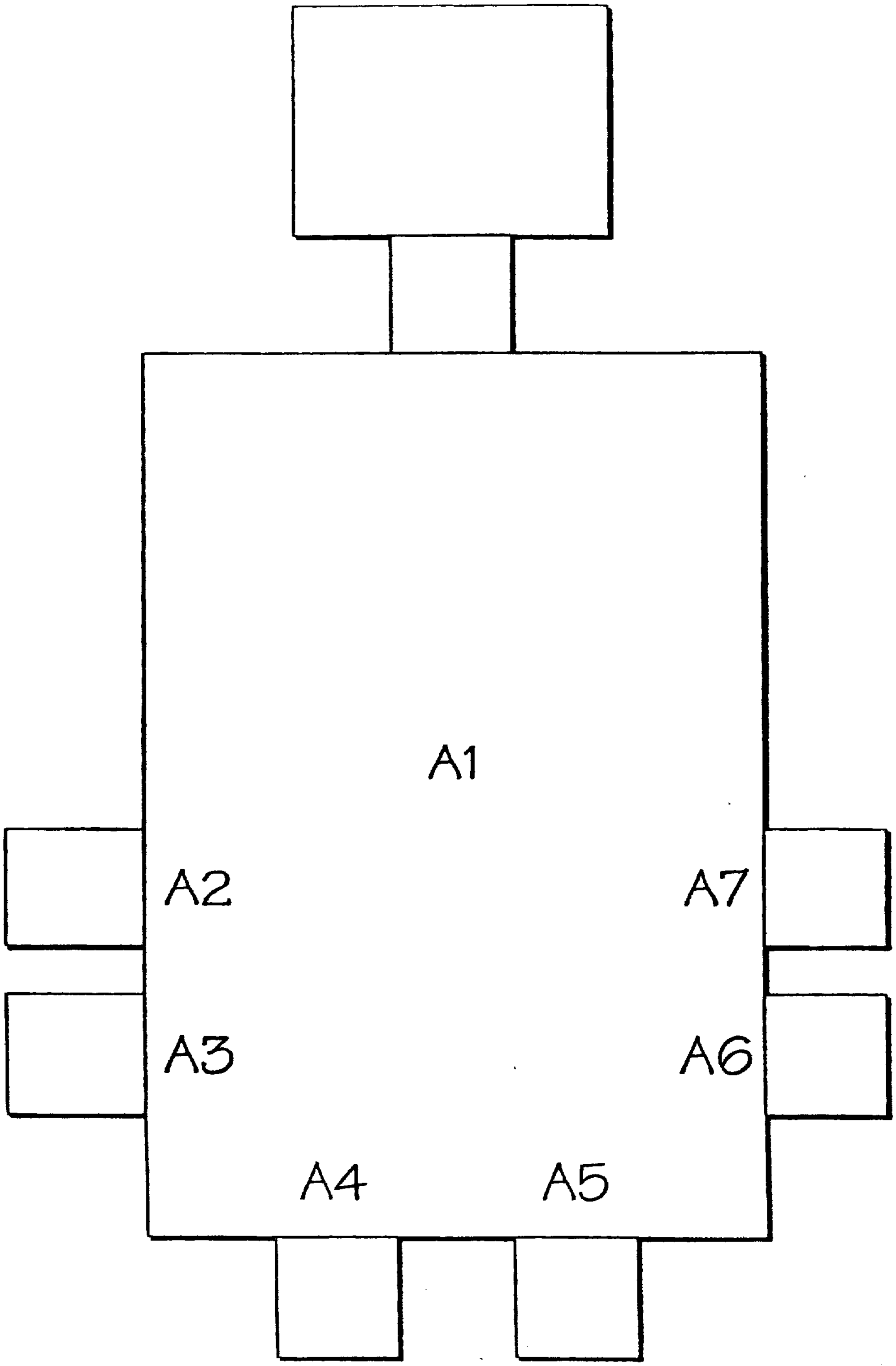

+5V
2
4
6
8
10
12
14
15
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
P37
P35
P33
P31
P29
P27
P25
P23
P21
P19
P17
P15
P13
P11
P9
P7
P5
P3
P1
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
P30
P26
P24
P22
P20
P18
P16
P14
P12
P10
P8
P6
P4
P2
P0

FIG. 63(K)



SP7
SP6
SP5
SP4
P26
P24
P22
P20
P18
P16
P14
P12
P10
P8
P6
P4
P2
P0
SP3
SP2
SP1
SP0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
IDC2X25M
J1
J2a
SP7
SP6
SP5
SP4
P25
P23
P21
P19
P17
P15
P13
P11
P9
P7
P5
P3
P1
SP3
SP2
SP1
SP0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
IDC2X25M
J1
J2b
MESH
SUPER PIN

Fig. 64


A1
A2
A7
A3
A6
A4
A5

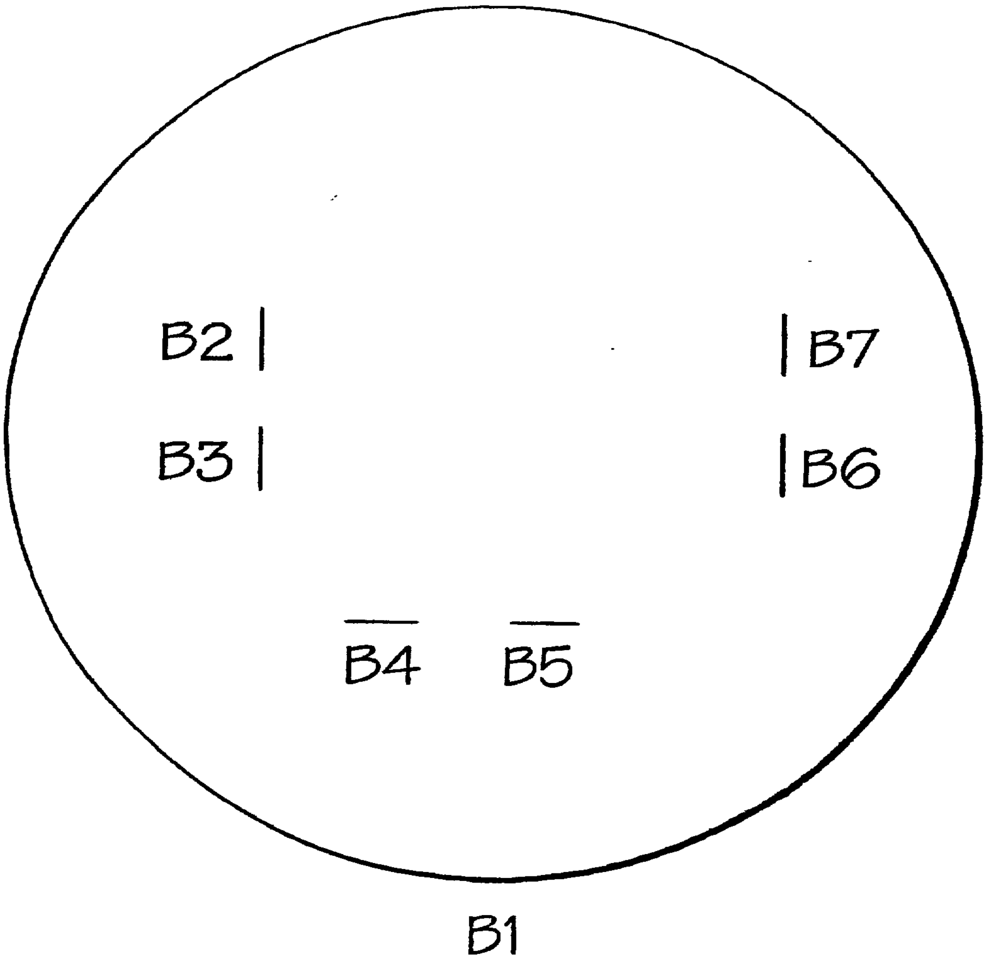
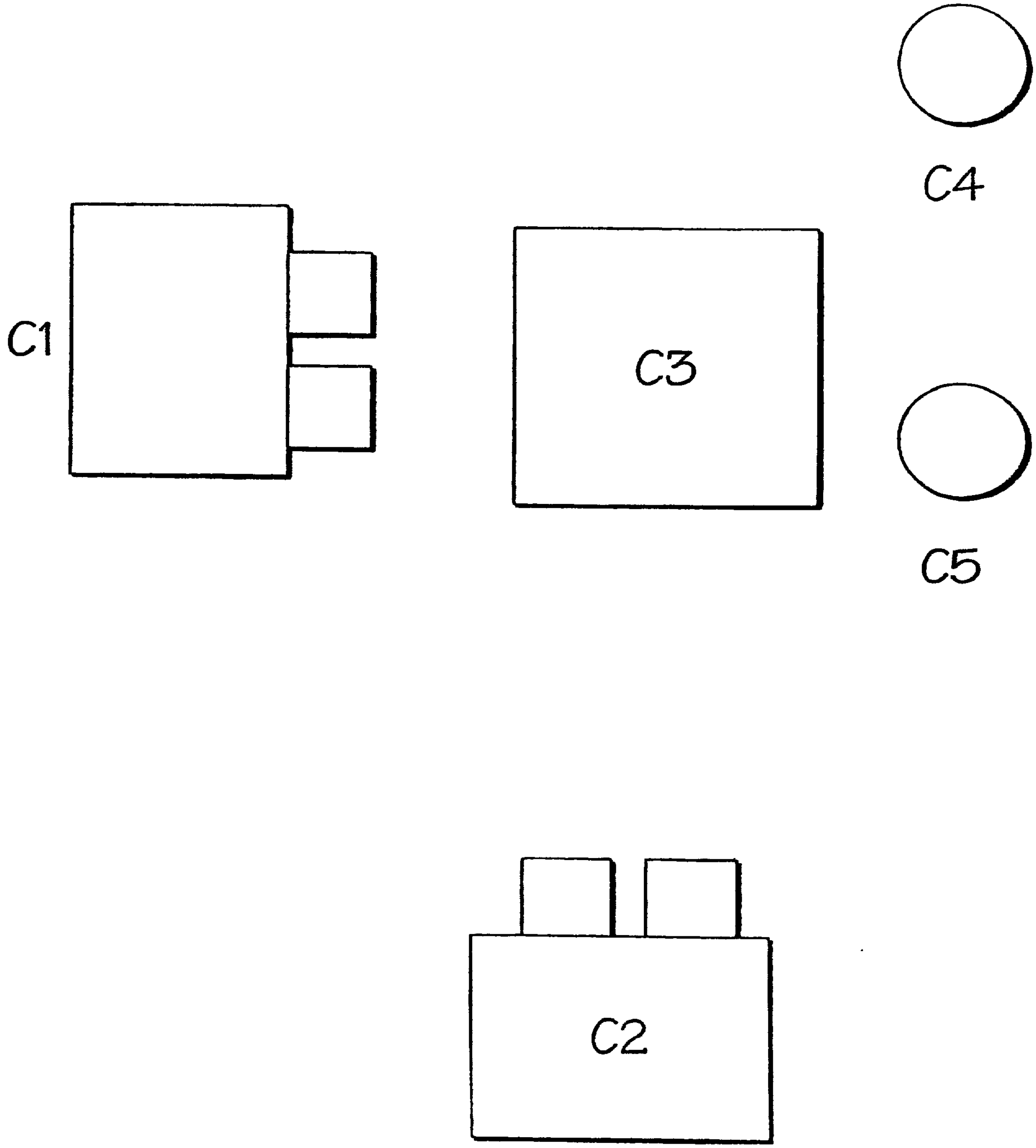


FIG. 66


C1
C3
C4
C5
C2

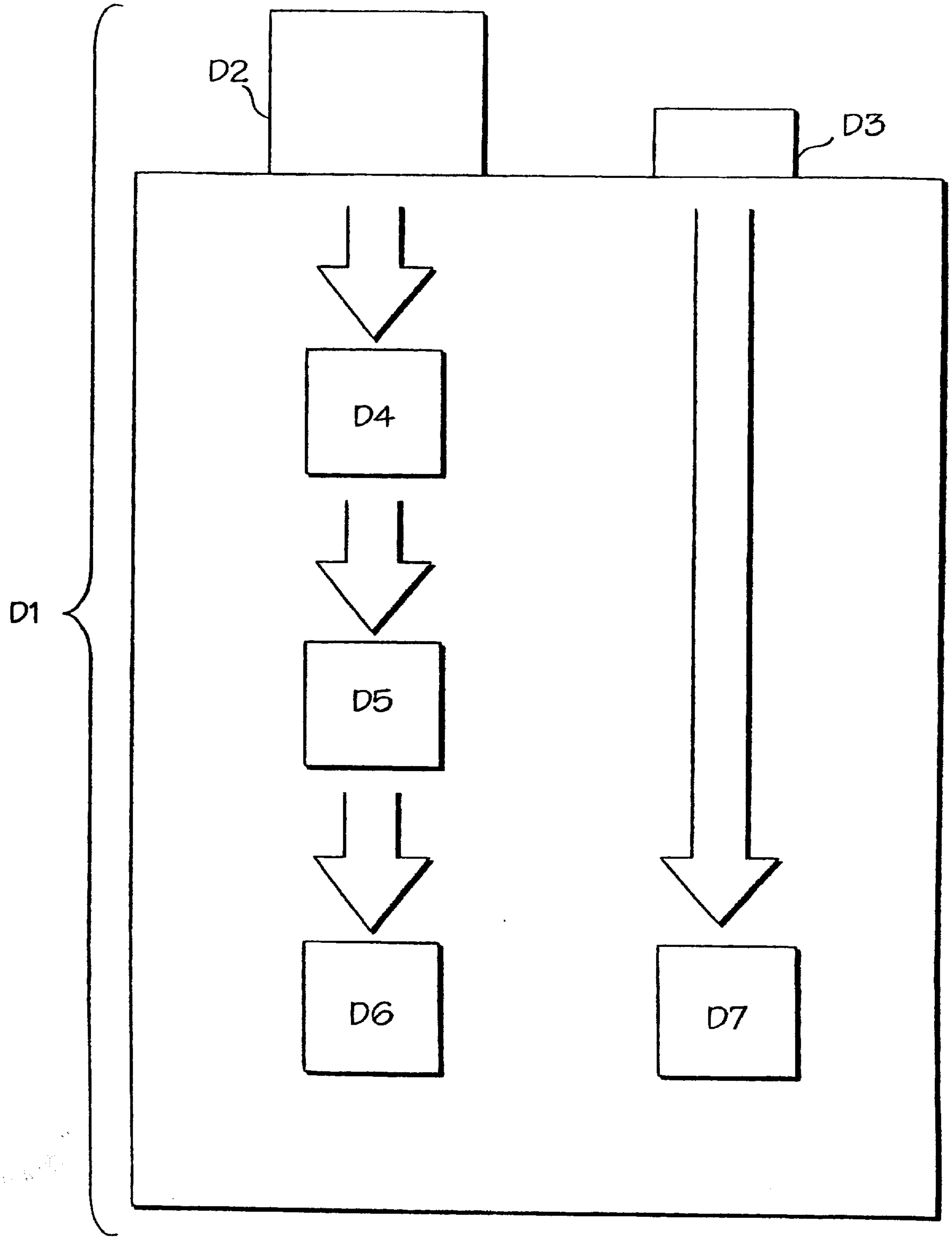


FIG.

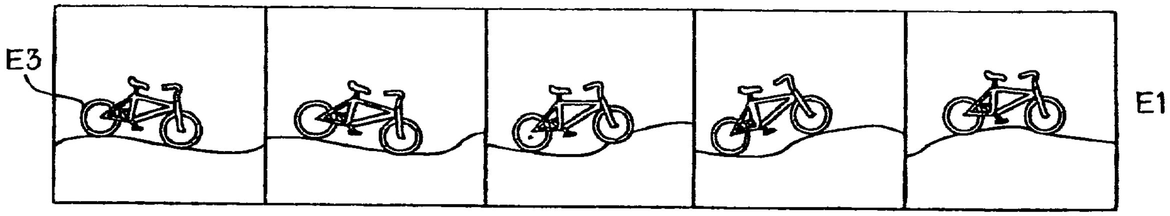


FIG. 69(A)

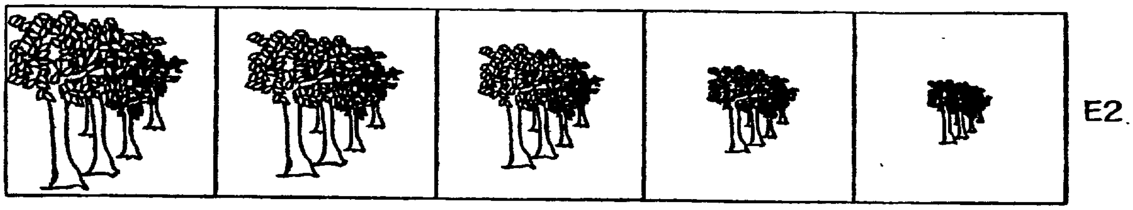


FIG. 69(B)

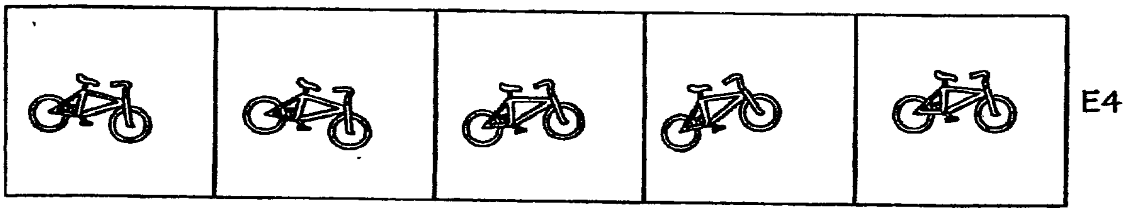


FIG. 69(C)

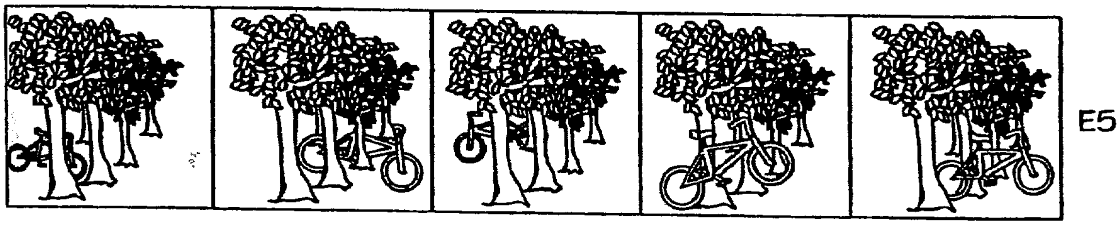


FIG. 69(D)